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Industrial Russia Surveyed.

Mr. P. Fox-Allin, our Associate Editor, having just returned from an extended tour of industrial Russia, has paid serious attention to the foundry industry of that vast country. In order that nothing should be lost by malinterpretation, here is Mr. Fox-Allin's general summary of the conditions.

Limitations of space make it impossible for me to do other than briefly review the industrial activities of Soviet Russia as I saw it on my recent visit. It would be unfair to make any comparison with other European countries; we must consider Russia as she is, and perhaps our thoughts may turn in the direction of what she might have been.

Russia, rich in natural resources and for the most part undeveloped, offered a virgin field for industrial undertakings, and as the Soviet very wisely called to her assistance some of the ablest men from many countries, the foundations for her various activities were built upon the accumulated experience of the industrial world. Her people, for countless generations no better than serfs, were accustomed to privations, and thus they accepted, as a matter of course, the additional hardships which were incidental to the putting into operation and the working of the Five-Years Plan. Opinions may very well be divided with regard to the methods employed by the Soviet, but there can be no two opinions, no room to question the results which have so far been achieved as the outcome of those methods. In so far as the erection and the equipment of works are concerned there is little doubt that the first Five-Years Plan will be carried out in its entirety.

From the experience of my visit I have no hesitation in saying that very few of the works are economic; the majority, indeed, I am convinced, are wholly uneconomic. With the necessary brains, capital or credits available it is a comparatively simple proposition to build and equip a works. In carrying out this part of the plan, however, those responsible failed completely to take into account that uncertain factor—the human element. The men required to operate the works had to be drawn, for the most part, from the agricultural districts, and these men were put to work precision machine tools without even adequate supervision. The administrative staff for the works was equally inexperienced, and I found generally a lamentable lack of works organisation and co-ordination between groups of works engaged on processes.

Other contributory factors to the overall inefficiency are the heavy labour turnover, which averages about 20 per cent.; indeed, in some factories I was told that it amounted to so much as 50 per cent. The men leaving are sure of employment elsewhere, but the vacancies have perforce to be filled by wholly unskilled men. The seriousness of this labour turnover appears to be generally recognised, but apparently it is no one's business to check it, which surely could best be done by removal of the main causes—bad housing, unsatisfactory food, coupled with a complete failure to recognise that pay should be in accordance with the skill displayed. The lack of individual responsibility in the matter referred to is characteristic of the whole conduct of the works.

Generally, those responsible for the conduct of a works fail to appreciate the fact that low-priced labour is not of necessity cheap, because it cannot be dissociated with the time factor. To point my argument—I visited a large foundry which represented the very latest word in mechanisation on the casting floor, but four men were employed to travel the metal ladle along an overhead Telpher. At the same foundry the pig, scrap and other raw materials were scattered over an area of several acres, from whence they had to be man-handled. It might have been, but apparently it was not, appreciated that the speed of the foundry was that of the slowest unit. I was told that labour is cheap—it is! A system of what was called "Works Accounting," which I saw in operation at one foundry and for which the men themselves were responsible, was both interesting and instructive, and I hope to deal with this subject at some length in a future issue.

Selling Castings.—2.

Wastes, other than those referred to in our previous issue, are not uncommon, and are due, in the main, to ignorance of consuming markets, or of the means for reaching them. Thus one man, who advertised a product for ten different uses, found that 80 per cent. of the users were concerned with one purpose only. By concentrating his advertising solely on this point large increases in sales resulted. In another case it was found that display material sent to 1,500 dealers was being used by less than 15 per cent. Again, the addition of new lines resulted in a manufacturer producing and selling 25 articles; eight of these represented 95 per cent. of his volume, and the remainder only 5 per cent. A greater profit was made by dropping the seventeen lines with their small proportion of the total demand.

It is becoming recognised that a successful business has to decide certain very important points, and a mediocre or unsuccessful business may often retrieve itself by giving these matters consideration in time. It is, first of all, necessary to determine what the business shall make and sell, together with how many different lines there shall be, and how many different sizes and patterns. The temptation to stray outside this field should be strongly resisted. The second point is fixing the prices at which the business shall sell. This is an extremely complicated question, and all the more complicated by the fact that very few business men can say with certainty what is the precise effect of a reduction or increase in price on the demand for the product. The third point is to settle to whom the business can and should sell what it proposes to make, and this is the thing which in

most jobbing foundries is left to such a large extent to chance. Furthermore it is necessary to settle the standard of quality which the business should seek to maintain, and so organise the manufacture that this standard is maintained as a matter of course without constant intervention at different points on the part of the management. Finally, the quantities which can, and should be, manufactured, should be determined.

We repeat that the above suggestions are the ideal which should be aimed at, and the more nearly they can be fulfilled the more successful is the business likely to be, and *vice versa*. They obviously imply that the demand should be constantly studied, so that the necessary decision can be taken with respect to the addition or withdrawal of certain lines.

A New Light Service Bureau.

We are aware that many of the large cities in the provinces have excellent showrooms organised by the local electricity supply authorities for demonstrating the latest developments in factory lighting, but after a visit to the newly-established Lighting Service Bureau, which has just been opened to the public at 2, Savoy Hill—the old B.B.C. buildings—we strongly recommend that every foundry executive when on business in town spare an hour to inspect this most interesting venture. Every foundry should have from 4-ft. to 6-ft. candles on cupola stage and fettling shops; 7-ft. to 9-ft. for rough moulding and 11-ft. to 13-ft. for precision work. We shall not be satisfied until we see these minimum figures established in every foundry. Whether regarded from the angle of a minimum service to the customer or to provision against accidents it is to-day an essential.

Machine shops may carry as much as 20-ft. or 25-ft. candles, and persons going from such a shop to an ill-lit foundry or *vice versa* may easily suffer an accident from blurr or dazzle. In arranging the lighting of foundries, it should be remembered that the black floor makes lighting much more important. Now that so many foundries are considering this question for the coming winter, a visit to the Bureau will be extremely helpful, as they will receive gratis reliable information as to height, type of lamp to use, upkeep cost and multitude of similar information. Whilst we were given a 40-page booklet "Electric Illumination Handbook, No. C.2," which is full of extremely useful information of the type required by foundry executives, and we strongly advise those unable to visit Savoy Hill to ask for the favour of a free copy.

Imported Bolts and Nuts.

The Import Duties Advisory Committee has received applications for increased import duties on bolts, nuts and screws of iron or steel or non-ferrous metals (other than screws for wood); iron and steel rivets; metal boot studs and hob nails; and shoe nails and rivets of iron, steel or brass. Any representations which interested parties desire to make in regard to these applications should be addressed in writing to the secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, London, S.W.1.

New Cobalt-Iron Alloy.—Darwins, Limited, of Sheffield, are now marketing a new cobalt-iron alloy containing 30 to 40 per cent. cobalt under the name of "D.C.I." It is characterised by extremely high flux densities at moderate magnetising forces. The alloy is intended for incorporation in magnetic circuits required to produce very high-flux densities across narrow air gaps. It is claimed to be suitable for pole-pieces and apparatus for the interconversion of electrical and mechanical energy, such as are used in sound-recording and reproducing apparatus, particularly where excessively-high magnetising forces are not desirable.

District Presidents.—No. 5.

SHEFFIELD BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN

MR. C. D. POLLARD, the President of the Sheffield Branch, served his apprenticeship in the drawing office and pattern shop at Messrs. John Brown & Company, Limited, Sheffield, during which period he attended the evening classes of the Sheffield Technical College as a student in engineering science. On completing his apprenticeship he left Messrs. Brown's and went to Messrs. Thos. Firth & Sons, of Norfolk. After a short stay at various foundries away from Sheffield, he accepted an offer of a position as junior assistant to the foundry manager at Messrs. Firth's, ultimately becoming chief assistant in the department. At the end of 1929, when Mr. Melmoth (who had been manager at Messrs. Firth's since early 1926) decided to go to America, the control of the foundry was placed in his hands.

At the beginning of 1931 the firms of Messrs. Thos. Firth & Sons and Messrs. John Brown & Company, Limited (whose steel foundry was situated at Scunthorpe, Lincs), amalgamated,

MR. C. D. POLLARD.
(Chairman of the Sheffield Branch of the Institute of British Foundrymen).

and the Norfolk Works Foundry of Messrs. Firth & Sons was closed down, except for the production of special stainless-steel castings. Extensive alterations and additions were carried out at the Scunthorpe Foundry to facilitate production of larger classes of work which had been done at Norfolk Works, and on completing the reorganisation of the two foundries and the merging of the staffs he was appointed foundry manager of the Scunthorpe Works. Before leaving Sheffield Mr. Pollard was actively interested in the work of the foundry section of the Sheffield Trades Technical Society, which is carried on at, and controlled by, Sheffield University, and after holding various offices he was elected President for 1928-9 and re-elected for 1929-30. This society makes a special effort to offer facilities to tradesmen and youths who have not had early technical training to discuss their shop difficulties and problems. In this and the boys' welfare work he was specially interested and realised that such efforts were raising the standard of workmanship in their shops. Prior to his election as President, Mr. Pollard served on the Council of the Sheffield Branch of the Institute of British Foundrymen and acted as Junior and Senior Vice-President.

Random Shots.

"Marksman" hasn't any statistics he can spring on you as to what percentage of the population tobacco smokers form. The proportion, however, must be a large one. And quite probably, if all the cigarettes smoked in a year in this country were placed end to end—before they were smoked, of course—they would stretch a tidy distance. According to one expert estimation (made, can you guess, by whom?), they would measure at least 438,000,000,000 inches, or, say, 6,900,000 miles. Having been stretched on the ground, by the way, they ought not then to be smoked. But some assumption always has to be made in affairs like this: as in the sum about the little boy who eats ten apples in an hour and will, therefore, providing he doesn't burst, eat eighty apples in eight hours.

* * *

"Marksman" himself is a cigarette smoker, not an unduly heavy one. He cannot be; he weighs only "ten stun three," according to the talkie weighing machine. He has a friend, a non-smoker, called, let us say, "Y." When the two spend an evening together, the arrangement is this. Every time "M" (no, not the Düsseldorf murderer, but merely "Marksman" in brief) lights a cigarette, he has to give "Y" a caramel. Really, the number of caramels "Y" absorbs in the course of an evening . . .

* * *

What set "Marksman" on the topic of smoking was the receipt of a review called "Clean Air," which is issued by the National Society of Non-Smokers. In case you haven't heard, the Society was formed "in the cause of Health, Equity and Good Manners, to stem the tide of Tobacco which is engulfing the Nation in its Gigantic Wave of Smoke." Anybody who objects to being engulfed is adjured to join the Society. The minimum annual subscription is a couple of shillings, when the badge costs sixpence extra; but the enthusiast pays a founder annual subscription of five shillings and gets his badge and literature free of charge. "Literature" includes "Clean Air" and other pamphlets, including two for young people:—"Is it Worth While to Smoke?" and "Ted's Bicycle."

* * *

The following quotations are taken from two editorials in the review; the first from an article on "Smokers' Logic," the second from "No Clean Air at Sea":—

"Imagine the horror, even for the smoker, of taking food in a crowded restaurant where every single person was smoking!! What flavour could be detected in the fare provided?—Or consider a crowded theatre or cinema in which every single person was smoking!! How much of the entertainment would be visible?"

"Moreover, there is concentration on board ship, and it may verily be said that there is scarcely any way of escape from the pungent fumes of burning tobacco. The lungs and the stomach, which came to the sea for ozone, are pursued into every nook and corner by this poison, leading to a continual nausea."

* * *

A set of lungs and stomach being pursued into every nook and corner. . . . Walt Disney ought to be told about this!

* * *

SHE WAS ONLY A WELDER'S DAUGHTER.—But she had a set o' lean limbs.

* * *

Have you heard about the sweet young thing who was looking in her wardrobe for her new bathing costume?

At first she could not find it, but in her search she turned over a moth ball.

The mystery was solved. The costume had been hidden by the moth ball.

MARKSMAN.

62nd Annual General Meeting of the German Foundry Employers' Federation.

First Day.

The general meeting of the German Foundry Employers' Federation was held this year at Goslar on September 2 and 3, there being present representatives of the authorities, the technical colleges and mining academies, allied societies and the Press. In view of the bad economic conditions, a purely business programme was again arranged. The members, who attended from all parts of Germany, worked together in the most earnest manner in discussing the most burning and vital questions, and in fostering union.

On Friday, September 2, after a meeting of the General Council, Prof. Dr. Aulich, of Duisburg, gave an address on "Guiding Lines for Moulding-Sand Control based on Research to Date."

Pointers for Moulding-Sand Control based on Recent Research.

By Dr. Aulich.

Moulding sand is a technical term for fragments of sand, produced by weathering and transformation processes from solid rocks or obtained by crushing sandstone containing clay, and which have been employed from ancient times as a moulding material for foundry purposes on the basis of experience alone. It is only in recent years that a beginning was made in the investigation of the suitability of moulding sand as a mould material, in order thereby to secure reliable results in working. This suitability rests on the determination of the technically important properties, such as sand and clay content (both of which characterise the sand as coarse or fine grained, fat or lean), the permeability to gases and the strength, given by the texture or structure on compressing after the addition of sufficient moisture to ensure that capacity for moulding which is essential for the production of a serviceable casting. Moulding-sand control must therefore commence at the place where the sand is obtained, *i.e.*, the composition and properties of the sand as it is in the pit must be determined, and these supplied in a regular manner by the adoption of proper means of winning.

In this way the ordering of moulding sands by the foundries would be greatly facilitated, especially if the most important pits in Germany, with the characteristics of the products, were known in foundry circles. This survey of the moulding sands of Germany, to be drawn up in the form of a classification according to grain size and clay content, is an object to be striven for as the basis on which moulding-sand control can be built up. The behaviour in the foundry of the sand received is to be closely followed, the test results with the sand mixture as used in the moulding shop will indicate which numerical values are appropriate to ensure the best results for the class of articles to be made. Constant supervision will then show when the minimum values are not reached, and a renewal of the mixture becomes necessary. In foundries in which continuous tests on the freshly-delivered sand and on the sand in use have been introduced, it has been found, certainly after persevering for some time with close observation of all occurrences and the evaluation of all experimental data, that not only are the quality of the castings improved and the quantity of scrap reduced, but above all there is a psychological effect on the workmen employed in the foundry, who co-operate in the effort to obtain the best possible product from their labour. There need be no hesitancy in allowing the simple tests to be made by an old moulder. He will soon realise that the "Feel," which was formerly solely available, is not sufficient for the expression of an expert opinion on the suitability of a moulding-sand mixture.

Second Day.

The actual general meeting was held on Saturday, September 3. In a private meeting in the morning the formal business was first disposed of. This was followed by a discussion on the economic position of iron foundries and a statement regarding the raw-material markets—pig-iron, cast-iron scrap, coal and coke. The meeting closed with an address by Dr. Fritz Schröder, of Bendorf, on "Modern Cost Calculation in Light-Castings Foundries."

The public meeting in the afternoon was opened by the President, Baron von Wittgenstein, of Laasphe, with an address of welcome, in the course of which he reviewed the general economic situation and its effects on the foundry

Baron von Wittgenstein

(*President of the German Foundry Employers' Association*).

industry. The animated discussion which followed was introduced by a very interesting contribution from Prof. Dr. Leidig, of Berlin, in which he threw light on the present politico-economic position.

In conclusion, a report on the activities and economics of the Federation for the year 1931-32 was presented by the Director, Dr.-Ing. Geilenkirchen, of Düsseldorf.

Presidential Address.

By Baron von Wittgenstein.

The main problem at present is an effective reduction in costs of manufacture and the re-establishment of economic production. The fourth emergency decree only represented a first step in this direction, followed unfortunately all too soon by new burdens. Here a clear picture was presented by means of figures showing how business was loaded with wages and salaries, interest and social charges, and the direct effect of reduced output in increasing costs. However much an early reduction in interest rates is to be desired, the depreciation of private credit abroad through the numerous references in the Press to a statutory reduction of debt is to be greatly deplored. Foreign confidence in German business rose almost automatically with the new decisions of the Federal Government, and it is to be hoped that by private efforts a reduction in the rates of interest for both private and public foreign loans will be shortly secured.

The new decree and the relaxation in the wage and rate arrangements which have been announced are of great importance. Without this step the meeting was in agreement that it would have been impossible to take up effectively the problem of the provision of work and the reduction of unemployment. The President declared that the only possible way had now been found to bring in private means to assist in the provision of work, and to give it the opportunity to do so. He referred to his statements in an article in the "Bergwerkszeitung" of May 20, in which he exposed the mistaken proposal of a compulsory loan and expressed the view that those employers who increased the number of their workers instead of having increased tax burdens must receive premiums, which would be an incentive to and facilitate further increases in employees. Of great importance in this connection is also the freedom from the rigid wage-rate control, which in this time of unemployment has for a long period become a farce. With very drastically reduced production the employer must have freedom to himself arrange the most suitable and economical distribution of his workers. At the same time this necessitates a special realisation of responsibility on the part of employers. Each abuse of this freedom would give the trade unions a new stone to cast against the capitalist. Evidence must now be given that employers, without Government or trade union interference, even in an economic crisis such as never previously experienced, can employ not only a pencil but also sympathy in fixing wages.

From the commercial point of view the most important condition for economic recovery is political quiescence, which would give consumers heart to return to the normal covering of requirements. For years purchasing has been from hand to mouth, and restricted to absolute necessities in the case of manufactured goods. Here, however, it is important that a new official lowering of prices shall not be introduced in connection with the large Government programme, since it would only occasion a fresh suppression of demand. In so far as the price basis may undergo a still further drop, this will come automatically as the result of the excessive competition.

Tariff Barriers.

Important questions still remain to be solved; above all, the overcoming and pulling down of the towering duty walls in the various countries which are markets for Germany, but here also concord in regard to tariffs and economic matters at home must come first. The President referred in this connection to the opposing views between the raw materials and manufacturing industries and between industry and agriculture in regard to tariffs, and emphasised the declaration of the Federal Chancellor that every change in tariffs which favoured one party could not represent an effective forward step. There is also need for public peace between north and south, west and east. However just the demands of the different States for the preservation of their rights and however important a sound decentralisation may be, at present all these questions must be subordinated to the support of the Federal Cabinet which, in the short time it has been at work, has demonstrated the will to act and the way to building up along broad lines with a definite aim. The speech concluded with the words "Unity and right and freedom for the German Fatherland."

Activities and Economic Position of the Federation.

By Dr.-Ing. Geilenkirchen.

The position of the German iron foundries has again been very bad during the past year, corresponding to the increased economic depression. The number of workers employed in the member works, normally approximately 100,000, fell from 83,000 on April 1, 1928, to 25,000 on April 1, 1932; on July 1, 1931, it still amounted to 36,000. Since a number of the workers who are still in employment are on short time, it will be seen that the extent to which the iron foundries are at work has fallen to 20 to 25 per cent. of their normal capacity. In the period of four years mentioned the membership of the Federation has been reduced from 1,075 to 785 firms, of which 213 firms have voluntarily given up the foundry business; 95 firms have failed and 105 have effected a compromise. The majority of the last-mentioned firms then resumed work. The position of the foundries will only improve when the whole German industry again moves upwards, a condition of which is the ending of the world economic crisis. The hunger of the foundries for orders is so great that very many of them are inclined to accept orders at any price and to carry the resultant losses, so long as they can keep their works going. Such a practice, during so long an economic crisis, can, however, only lead in the end to that collapse which it is intended to prevent. The task of the Federation is to remove all difficulties which stand in the way of securing orders, and remunerative orders at that. For this it is in the first place necessary to overcome the tariff barriers which stand in the way of export trade.

International Foundry Cartellisation.

By cultivation of international relations with foreign trade associations, the Federation hopes to promote the basis for an economic understanding between the nations; for this reason it is desirable that, in spite of the economic difficulties, as many as possible from Germany should visit the international Foundry Congresses to be held in Paris the week after next. In the negotiations of international commercial treaties the Federation has always been represented by experts. In such negotiations during the past year it was possible to prevent the imposition of an additional 15 per cent. duty on castings entering Italy, the request for which was made from the Italian side. In all such negotiations it is naturally necessary to weigh up the demands of the different branches of the industry against each other; on occasion the wishes of individual industries, however much they may be justified, have to be put aside on account of the necessities of the majority. Despotic action is naturally avoided, and a proper balance demanded between the demands of industry and agriculture, as stated by the Federal Chancellor in his latest speech on the programme. Export is promoted by the rebates on the pig-iron contained, certified by the Pig-Iron Association, and the amount of which is calculated by the Federation in collaboration with the Avi. An important rôle is also played in regard to export by the port special railway rates and the special rates for export over the frontiers. In this connection also very different wishes are often expressed by different branches of industry and from the various economic districts of Germany; it is a principal duty of the Federation to bring about reasonable adjustment between these. The existing special rates were further reduced by the reform of November 1, 1931. In the inland freight rates, which it is well known are too high for the whole industry, the last-mentioned reform has also brought a number of individual improvements. Subsequently, following the emergency decree of December 8, the whole of the rates were reduced, those classes being specially given consideration in which the foundry products are mainly consigned. A special benefit was secured for the iron foundries by the de-rating of unmachined castings under 100 kg., which was requested by the Federation and agreed to by the standing Rate Commission after very prolonged negotiations. There have thus been secured for the foundries during the past business year a number of valuable reliefs in regard to freights. In this matter and in other directions the Federation has constantly worked in co-operation with the leading industrial associations, on the one hand, the Federal Union of the German Industry and the Langnamverein, and on the other with the Association of German Employers' Federations, the General Federation of German Metal Industrialists, as also the North-West Employers' Federation, in order to further the interests of the whole iron-foundry industry, and also to support in individual cases those foundries which have asked advice from the Federation in connection with taxation, labour questions or doubtful cases in regard to the social laws, etc.

Raising Selling Prices.

The Federation regards as a most important duty the provision of bases which will enable its members to secure satisfactory selling prices. On account of the very great differences between the groups of castings this question is exceptionally difficult, and it was only at the general meeting held a year ago at Berlin, after many years of preparation, that it was possible to provide a suitable basis by setting up a graded-minimum price list for hand-moulded castings for machinery for three different economic districts, *i.e.*, West and North Germany, Middle and East Germany and South Germany. This minimum price list, after the proposals of the general meeting had been accepted by the local groups of the Federation, had gradually begun to operate in a favourable manner, when the whole development was sharply upset by the effect of the emergency decree of December 8, with its 10 per cent. reduction in fixed prices. A number of the foundries had, with a view to the mutual adoption of the prices, already made heavy sacrifices in September, so that it was impossible to demand a further reduction from them, which was also not required from them under the emergency decree, whilst other foundry groups in the same district which had not reduced their prices were compelled to do so by the emergency decree. The result was that the division into three economic districts, accomplished after so much trouble, was, at any rate for the time being, undone, and it is only now that efforts in this direction can be resumed after the embargo period, provided by the emergency decree in regard to price agreements of the nature of cartels, expired on July 1 of this year. In the meantime, however, a further considerable decrease in the demand for iron castings set in from the beginning of the year 1932, amounting to 30 to 35 per cent., and as a result of the general hunt for orders which this has occasioned the whole level of prices in the foundry industry has sunk to a level at which the production costs are far from covered. The efforts of the Federation again to secure sufficient prices for its members, which have now been resumed and which extend beyond the margins laid down in the previous year to the fixing of prices for definite groups of castings, must be recognised as justified by all those who would not agree that those belonging to such an important branch of industry, which employs a large number of workers, should face certain ruin as the result of constant insufficient selling prices.

Builders' Castings.

In the case of hardware and builders' castings, the efforts for the setting up of minimum price lists have been continued with success. The matter is here certainly simpler, since the products are not so variable and strongly-united associations already exist for a section of special hardware castings.

With the setting up of appropriate basic prices there is bound up the preparation of sound sale and supply conditions, by which the members of the Federation will be protected against losses of all sorts, which might be occasioned to them through supply agreements which are not free from legal faults. This applies, for example, in regard to the retention of ownership of delivered goods until they are fully paid for, which is of especial importance to suppliers at the present time when even highly-esteemed firms, apparently with a good backing, fail over night. The Federation can take special credit for the fact that its sale and supply conditions were so carefully drawn up years ago that the fundamental ideas on which they are based have been recognised when it has come to a law case, so that many members have been protected against considerable losses on failure of their customers.

Scrap Buying Activities.

The supply of raw materials to the foundries has presented no difficulties in view of the restricted demand. In the pig-iron market the offer of cheap foreign pig-iron, for instance, after the fall in the English pound, caused an unpleasant competition to the German pig-iron suppliers. An exceptionally heavy fall has occurred in the cast-iron scrap market, amounting to 25 per cent. within the year. The meeting of the demand for cast scrap, especially light-castings scrap, has been very difficult in many cases in spite of this, so that the Cast-Iron Scrap Buying Company of the Federation has been again compelled, despite the troubles in regard to bills, to import whole shiploads of light-castings scrap from England. Unfortunately, the Federation has been unable up to the present, in spite of this obvious scarcity, to convince the Federal Commissioner for Export Permits that the export of this type of cast scrap is an economic absurdity, and unfortunately at the same time large quantities of light-castings scrap have gone to Belgium, in part under another description. The lack of liquid assets has prevented the foundries from providing themselves with large stocks of scrap cast iron in spite of the low price; in this connection the Cast-Iron Scrap Buying Company have made purchases for stock of individual classes of scrap, so that when trade improves it will be in a position to fulfil its proper function in stabilising the market.

Russian Specifications.

The comprehensive experiments which the Federation has carried out in conjunction with the Rhenish-Westphalian Coal Syndicate to mine the requirements for the production of a specially-suitable foundry coke are provisionally stopped. They have led to the satisfactory result that the coal syndicate is now in the position to proceed in their coke-oven plants with the production of a good foundry coke. Also the moulding-sand investigations carried out by the Federation, of which the head, Prof. Dr. Aulich, has presented a full report, are at an end and provide a valuable basis for the introduction of a correct control of moulding sand. For the rest, in the handling of technical questions attention has been limited to the most vital problems of the foundry industry; in this comes first the negotiations carried out in conjunction with the Association of German Machine Tool Makers with the Russian Trading Commission in regard to the specifications for machine-tool castings. It has been possible to persuade the Russians that their demands were excessive and to get these reduced to an extent that they can be easily complied with by any well-conducted foundry. The conditions now provide a good foundation for an extension of the Russian business, consequently an increase in

the market possibilities for iron foundries. Another question of equal importance for the maintenance of the possibilities of sales of castings is the contest against the extension of the use of welded construction. On many sides the propaganda for this purpose has been carried so far that lay persons might be inclined to regard the whole foundry technique as overtaken by this modern development. The Federation, in conjunction with other foundry associations, has taken effective action against this impression by technical investigations and public explanations. The foundries can only succeed against such competition in the end so long as they supply their products as effective, high grade and at the same time as cheap as possible. All these objects will be best attained if the foundries join together into a phalanx which is ready to act together in the contest for its existence and to take action against the depreciation of its importance by other branches of industry and at the same time is sustained by the belief in its resuscitation. It is a matter for exceptional pleasure that the Federal Chancellor in his latest speech brought into the plan the free and responsible capitalist; the German iron foundries will not fail in co-operation.

Modern Cost Calculation in Light Iron Foundries.

By Dr. Fritz Schroder.

The starting point is the experience that the costing systems proposed for foundries in recent publications have only seldom exercised an educative influence on the practice of the small and medium works, which include the majority of the German light-iron foundries, and further, as they have been mainly devised for engineering foundries, they are, on that account, hardly suited to the requirements of light foundries. The latter are therefore taken as the mid-point of this investigation, and suggestions are given for the improvement of works-costing with the object of providing exact data for job costs and for supervision of operation.

These proposals, based on the methods of costing actually employed in light-castings foundries, consist of the development of the process in the direction of finding departmental oncosts, works control costs, floating overhead and the systematic observation of the effect of variation of output on the actual works cost. The details considered are: The systematic use of departmental costing and its refinement in the matter of group costing, both illustrated by examples for the melting and casting departments; also the inclusion of depreciation and interest on capital in the periodic control accounts, with methods of facilitating the comparison of monthly summaries, such as averaging heavy items of expenditure and eliminating the effect of the fifth week on the monthly totals of costs; further, the accurate distribution of the general overhead over the three main sections of industrial operation; materials, manufacture and sales, with especial reference to the materials overhead charges so frequently overlooked; finally, the investigations rendered necessary through observation of the extent to which the works are employed. Among these are included, as fundamental preliminaries, determination of the maximum output capacity of the business and the actual proportion produced, for the provision of data for calculation of prices; fixing the averages and limiting minimum prices for the works production, *i.e.*, the proportional costs based on the determination of the fixed charges; for the provision of data for the supervision of operation; finding the normal and standard values for the job works costs and especially the general overhead for various degrees of employment.

The results of these proposals were compared with those given by the usual costing methods employed in practice. With reference to the calculation of prices, they made evident sources of loss due to incorrect estimates for the finished products, the errors in which are to be sought in leaving out of account the exact costing by departments and groups as well as of refined works control or reconciliation accounts. To secure stability in the quoted prices it is necessary to use normal rates for the general overhead, the required basis for which is given by weighted averages or obtained graphically from frequency curves. In regard to the supervision of operation, group costing and the distribution of the general overhead provides much finer indications than are given by the figures to be obtained from the usual methods of costing. The same applies to the normal and standard values of the general expenses, for which the preparation of an elastic general expense budget for various degrees of employment is possible. Further, the intelligent evaluation of the results of group costing lead to a knowledge of the technically best method of production, the evaluation of the standard costs to an approach to the maximum economic efficiency and utilisation of the works and to the highest development in regard to the production cost of a job.

The Fe-Co-C System.

The constitutional diagram for iron-cobalt alloys containing up to 5 per cent. carbon has been investigated by R. Vogel and W. Sundermann by means of cooling curves, microscopic examination of the structure and magnetic measurements. The results were published in a recent issue of "Archiv für das Eisenhüttenwesen," with projections of the solid diagram and sections for various proportions of iron to cobalt, *i.e.*, 49:1, 29:1, 9:1, 7:3, 1:1 and 3:7. Three types of primary crystals separated out, namely, ternary α-solid solution, ternary γ-solid solution and graphite. Primary separation of cementite was not observed with the cooling rate employed, 1 to 2 deg. C. per sec. The eutectic consisted of ternary solid solution and cementite or graphite. The ranges in which the eutectic contained cementite or graphite were separated by a transition zone in which both phases occurred side by side. Alloys in this range of concentration readily change from graphite to cementite in solidifying through slight differences in the cooling rate or the pressure.

The relation between the hardening capacity and composition of cobalt steels was determined for a definite rate of quenching.

The transformations in the solid state, with alloys containing up to 80 per cent. Co, led to pearlite, consisting of binary α-solid solution and cementite or graphite. For the test-pieces containing 80 to 94 per cent. Co. the γ-solid solution is stable at room temperature. The magnetic change point of iron is displaced to higher temperatures by the presence of cobalt, and coincides with the α-γ transformation when the carbon content exceeds that corresponding to the point 0 (German standardised Fe-C constitutional diagram, intersection of A_2 temperature line with the lower boundary of the area of single constituent solid solution). It was observed for alloys up to 70 per cent. Co.

The region in which martensite occurs in alloys with up to 10 per cent. Co and 2 per cent. C. was determined for a quenching speed of 65 deg. C. per sec.; neither austenite nor sorbite or troostite were observed.

Institute of Marine Engineers.—The Council of the Institute of Marine Engineers desire to remind young engineer apprentices and students of the educational advantages afforded by association with the Institute. Admission to the student section is obtained by examination. Arrangements are now being made for the next annual examination, which will be held in April, 1933, at various centres, according to the candidates' places of residence. Full particulars and copies of previous examination papers may be obtained on application to the Secretary, the Institute of Marine Engineers, The Minories, London, E.C.3.

Catalogues Received.

Electric Furnaces. — The General Electric Company, Limited, Magnet House, Kingsway, London, W.C.2, has prepared and issued a 16-page catalogue, which illustrates and describes a remarkably wide range of electric furnaces. In the introduction it is stated that the company "possesses exceptional facilities for the examination and testing of the materials used in the construction of its furnaces." This is no idle boast, as only last Saturday we made one of our periodic visits to their research laboratories at Wembley, and saw "life" tests being conducted on nickel-chromium alloy wires, refractories and grey-iron castings. Thus we can personally testify to the force of this statement. The next section deals with working costs, control, labour, atmospheric control and maintenance, and constitutes a veritable text-book on the subject. It must be understood that only resistance furnaces are being envisaged during the compiler's description. The next section takes in "Industrial Applications," starting out with iron and steel and dealing with such operations as tempering, cyanide hardening and salt baths, nitrarding, bright annealing, forging and high-speed steel hardening. In connection with nitrarding, we suggest that the first line of this section should be amended to read: "This is a process for the case-hardening of special steel *and cast irons* by exposing, etc.," as the British foundry industry is rather proud of its participation in (if not creation of) this particular development as applied to cast iron. The next section outlines the application of electric furnaces to the non-ferrous industry, and this, unlike the ferrous section, includes melting plant. After this, annealing, normalising, artificial ageing, lead pots and tinning baths are described. The balance of the book is devoted to vitreous enamelling ceramics, and industrial ovens for mould and core drying and similar purposes. The last page lists the information which should be given by inquirers. We think the insertion of a couple of loose sheets would be preferable to this. We suggest that the scope of the electric furnace in the foundry industry is so wide as to warrant the publishing of a catalogue specially devoted to its interests. Its contents could be made up of steel melting, iron melting and superheating, non-ferrous melting, annealing ovens for castings, nitrarding furnaces, vitreous-enamelling ovens and mould and core stoves. We throw out the suggestion as it has been more or less adopted by others similarly placed. The catalogue under review is artistic, admirably compiled and splendidly illustrated, and is available to our readers on request.

Moulding Machines.—Messrs. John MacDonald & Son, Nitshill, near Glasgow, have sent us a four-page pamphlet illustrating and describing the No. 2 "Manifold" simultaneous jar-squeeze direct-draw moulding machine (Neesham's Patent). This machine carries a 17-in. by 23-in. table and has a lifting capacity that is the dead load on the table of 500 lbs. The normal adjustable pattern draw is between 4 in. and 6 in., but it can be increased if desired to 8 in. The air consumption is stated to be 2 cub. ft. per half-mould. The feature of the machine is that one control valve actuates the whole sequence of operations; that is, it causes jarring, squeezing, vibrating and pattern drawing by moving clockwise or counterclockwise a single lever. The machine, though shown as a direct-draw machine, can be supplied as a turn-cover machine. This is very desirable in certain districts in Great Britain, where the sand used is of a weak nature.

Messrs. Blackstone & Company, Limited, Stamford, Lincs, have received an order for eleven sets of electrically-driven "unchokeable" sludge pumps.

Mould Materials for Non-Ferrous Strip Ingot Casting.*

By G. L. Bailey, M.Sc.

Introduction.

The work to be described in this Paper formed a portion of a comprehensive research on the casting of 70:30 brass strip ingots which has been in progress for some years in the Research Department, Woolwich, for the British Non-Ferrous Metals Research Association.

The experimental work in this section of the research was carried out almost entirely in the years 1927 and 1928, and enabled certain general conclusions to be drawn as to the characteristics desirable in a mould material for this type of work. More fundamental work on the heat transfer across the metal-mould interface was planned but has not yet been carried out.

FIG. 1.—70:30 BRASS INGOT CAST IN GREY-IRON MOULD, SHOWING EXTENSIVE "BLOWING" DEFECTS. × ⅔.

Previous Work.

Early records of the casting of brass strip ingots indicate that the moulds originally used were of stone. The weakness of this material led to its replacement by grey cast iron, which has been in almost universal use for many years. Cast iron offers the great advantages of durability, cheapness, and ease of casting to shape with a smooth surface; the average life of good-quality moulds is stated to be 2,000 to 2,500 heats. The readiness with which cracks are formed on the inner working faces of the mould, frequently at an early stage of its life, and certain other properties indicate that cast iron is not an ideal mould material. Little scientific work has been carried out on ingot moulds and the most suitable materials for their construction. Some attention has, however, been paid in recent years to the use, particularly for brass, of water-cooled copper-faced moulds, and to the behaviour of cast-iron moulds for steel casting.

Matuschka[1] has studied the thermal changes during the cooling of a steel ingot in the mould and has determined the temperature at different positions in the wall of a mould of commercial size. The fourth report of the Heterogeneity Committee of the Iron and Steel Institute, published in 1932, includes work on the thermal properties of ingot-mould irons by Pearce and Morgan[2] and by Donaldson.[3] In recent years a copper-faced water-cooled mould has been introduced and widely adopted for brass ingot casting.[4] In this mould a copper plate about 0.75 in. in thickness is provided with a jacket through which a continuous supply of water is run. It is claimed that such moulds have a long life and facilitate production, since they can be rapidly filled and evacuated.

Rohn[5] has also used, with considerable success, copper-faced water-cooled moulds of special design, for the casting of nickel alloys of high melting point, and claims a long life for these moulds even when surface dressings are entirely dispensed with. Roth[6] has discussed in general terms the application of water-cooled moulds to brass-casting. He made some measurements of the temperature gradient within the ingot using a water-cooled billet mould, and within the ingot and mould wall with cast-iron moulds. Erichsen[7] has more recently developed water-cooled moulds with Invar plates, which have been successfully used for brass-casting.[8]

Scope of Present Work.

The present work comprises a detailed study of the cause and avoidance of certain types of defect which are encountered in brass strip ingots when cast-iron moulds are used, and an examination of the properties of a variety of alternative mould materials. At the outset information was sought as to the moulds used and service obtained by a considerable number of manufacturers in this country. Cast-iron moulds were found to be almost universal, but in addition to their liability to cracking they are subject to another disadvantage—the evolution of gas from the mould face where the dressing is too thin or on account of local overheating, and the consequent formation of an ingot surface defect commonly termed "blowing." An example of this defect in an ingot of 70:30 brass is illustrated in Fig. 1. This gas evolution occurs in particular at the point of impingement of the stream on the mould face, and while not generally serious in casting brasses by the ordinary methods, it is more common with high-temperature alloys, such as nickel-brasses and cupro-nickel. The general commercial practice of dressing the mould heavily with a volatile carbonaceous dressing prevents this local overheating to a great extent, but during this research the disadvantages, from other points of view, of heavy volatile mould dressings have been demonstrated. Alternative casting methods which were developed, however, increased the severity of the conditions at the mould surface and intensified this "blowing" effect.

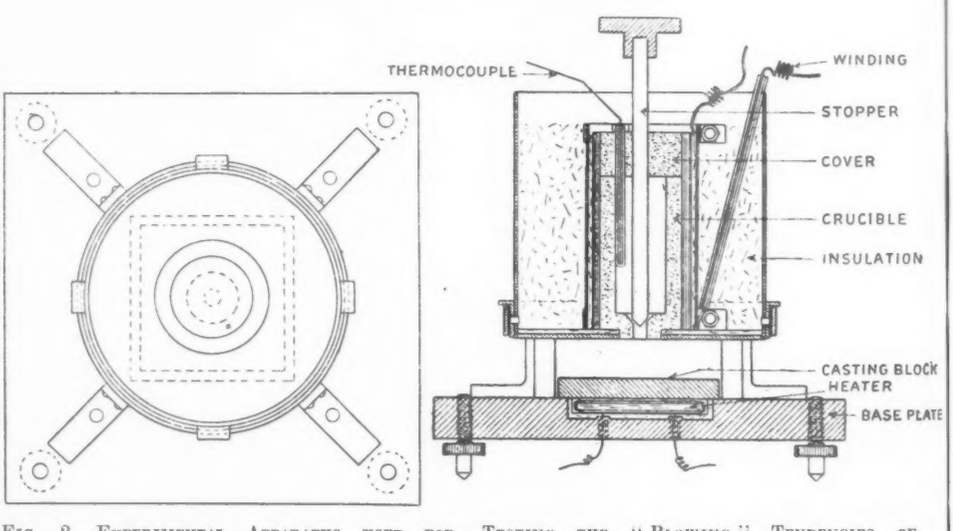

FIG. 2.—EXPERIMENTAL APPARATUS USED FOR TESTING THE "BLOWING" TENDENCIES OF MOULD MATERIALS.

A careful investigation of the origin of this gas-evolution from cast iron and other mould materials was therefore undertaken. The liability of cast iron to cracking, and of other suggested materials to distortion, was also examined in detail. Finally, the influence of mould materials on the structure and soundness of the cast ingot also came under consideration. It should be emphasised that throughout this work, the mould materials were examined with special reference to the casting of 1-in. thick strip ingots of 70:30 brass, but it is considered that many of the conclusions arrived at are directly applicable to the casting of other materials.

* A Paper presented to the Autumn meeting of the Institute of Metals. The author is Development Officer, British Non-Ferrous Metals Research Association; formerly Research Department, Woolwich, from which this Paper is a communication.

1 Matuschka, "Arch. Eisenhüttenwesen," 1929, 7, 405; and "J. Iron Steel Inst.," 1931, 124, 361.
2 J. G. Pearce and E. Morgan, F.T.J., May 5, 1932, page 272.
3 J. W. Donaldson, F.T.J., May 5, 1932, page 282.
4 Junker, "Z. Metallkunde," 1926, 18, 312; "Metallwirtschaft," 1930, 9, 406.
5 Rohn, "Z. Metallkunde," 1927, 19, 473–478.
6 Dr.-Ing. Dissertation, Aachen, 1929.
7 British Patents Nos. 358,697, October, 1931; and 299,850, May 1929.
8 The British Non-Ferrous Metals Research Association has made a special study of these developments, and has prepared translations and reports thereon for its members.

Occurrence and Cause of "Blowing" of Cast-Iron Moulds.

In the course of earlier experimental work, the following tentative conclusions had been drawn concerning the occurrence of "blowing": (1) Grey cast iron and semi-steel are liable to evolve gases, while dead mild steel under ordinary conditions of service does not show this property, and (2) gas-evolution only occurs where the mould surface is overheated either by impingement of the stream of metal or the use of an initially high mould temperature.

It was found that even when using thin mould coatings small ingots could be produced satisfactorily in cast-iron moulds if the stream of metal was central and the mould vertical, but where the stream was allowed to impinge on the mould face localised "blowing" usually occurred. When casting long ingots the avoidance of impact of the stream on the mould face was more difficult and in general rapid pouring with a heavier flow of metal greatly increased the extent of blowing.

FIG. 3.—UNDER SURFACE OF SMALL BRASS DISC POURED ON CAST-IRON PLATE, SHOWING "BLOWING." × ½.

Standard Small Scale Test of Mould Materials for Liability to "Blowing."

In order to obtain a rapid test of the "blowing" tendencies of mould materials the small-scale apparatus shown in Fig. 2 was devised. An electrically-heated carborundum crucible, arranged for bottom-pouring, was supported at a fixed height above a base-plate which carried a slab (4 in. by 4 in. by 0.5 in.) of the mould material to be tested. A wire-wound heater, recessed in the base-plate, provided control of the temperature of the mould material. A machined block of 70:30 brass weighing 180 grm. was melted, heated to 1,050 deg. C., and poured in a smooth stream on to the plate of mould material. A disc of brass about 3 in. in diameter was obtained, the under-surface of which showed characteristic "blowing" if the mould material was one liable to produce this defect (see Fig. 3). Measurement of the volume of the cavities in the underside of the disc by filling with wax gave a roughly quantitative comparison of the blowing tendencies of different materials.

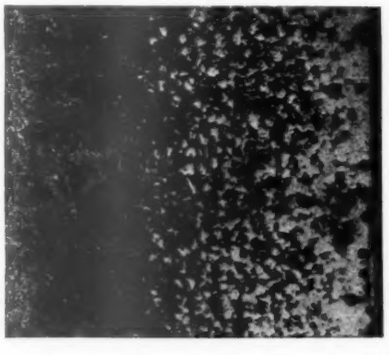

FIG. 4.—SURFACE LAYER OF DECARBURISED WHITE IRON PLATE. × 100.

Examination of Typical Samples of Commercial Mould Materials.

Information concerning the quality of the cast iron normally used for commercial ingot moulds was obtained by the examination of samples of worn-out ingot moulds obtained from the works of sixteen members of the British Non-Ferrous Metals Research Association. Analysis showed that the compositions of these specimens varied between wide limits (see Table I), while the specific gravities covered the range 6.80 to 7.15.

TABLE I.—*Range of Composition of Commercial Cast-Iron Ingot Moulds.*

	Per cent.
Graphitic carbon	2.5 to 3.1
Combined carbon	nil to 0.8
Silicon	1.5 to 4.0
Manganese	0.3 to 1.0
Sulphur	0.04 to 0.13
Phosphorus	0.14 to 1.2

The samples supplied had been in service for periods varying from 4 months to 10 years before failure—generally by cracking—but the information given was not sufficiently detailed to permit any correlation of life with composition. Where the size of the sample permitted, plates bearing the original inner surface of the mould were tested for "blowing" in the small scale apparatus. Seven plates, of widely differing compositions, tested in this manner showed small differences in the volume of gases evolved. It would appear that variations in the "blowing" of commercial grey-iron moulds are due more to varying conditions of pouring than to differences in the structure and composition of the iron.

Effect of Amount and Distribution of Graphite on "Blowing" Tendencies.

The cast irons tested were all of similar open grain, and porosity of the surface layers due to loss of graphite suggested itself as a possible cause of the gas evolution on heating. Preliminary trials of plates of non-porous materials, such as mild steel, copper, "aluminium-bronze," Nichrome and Acheson graphite all showed freedom from "blowing."

Experiments were therefore made to examine the behaviour of irons of widely different structures. Small plates were prepared of open-grain grey irons, white iron, and irons of intermediate or "mottled" structure. At the same time tests were made of "perlit" iron and also of "Black-heart" malleable cast iron—the latter after machining giving a surface layer of pearlitic structure.

In each case the under surface of the brass disc was "blown," the volume of the cavities being from 0.15 to 0.25 c.c. The variations obtained were of the same order as the differences in the results of duplicate tests on the same slabs, and are explained by later results. It was apparent from these tests, however, that the amount and state of division of the graphite in the surface layer of a cast-iron mould did not influence its behaviour as regards "blowing."

Possible Reactions Causing Gas Evolution.

The probability that the gases are evolved from the liquid brass, or from a reaction between the brass and the mould face, is small in view of the absence of "blowing" with mild steel and graphite moulds. That dissolved gases could be evolved rapidly and in considerable amounts from the mould material on heating at atmospheric pressure also appeared unlikely.

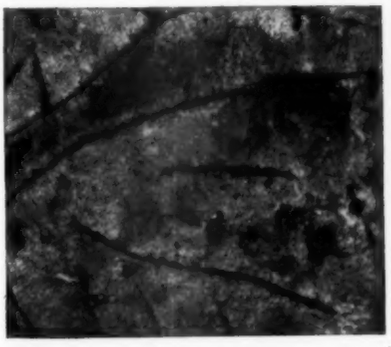

FIG. 5.—ORIGINAL STRUCTURE OF GREY CAST-IRON CYLINDER. × 250.

The possibility that gas could be formed by a reaction in the surface of the cast irons, involving a superficial oxide film and the carbon of the iron, was then considered. The surface of the cast irons previously tested were oxidised in varying degrees, and the reduction of this oxide by carbon when the mould surface was heated to a high temperature would be expected to result in considerable evolution of oxides of carbon.

To test this hypothesis experiments were made to determine:—(*a*) The influence of varying degrees of surface oxidation of ferrous materials of varying carbon content; (*b*) the temperature necessary for the surface reaction, and (*c*) the temperature attained by the mould face during pouring.

The Influence of the Degree of Oxidation and Carburisation on Liability to "Blowing."

Small-scale tests were made of the effect of varying degrees of oxidation on a variety of ferrous alloys of different carbon contents. The results obtained are shown in Table II.

The white-iron plate used for these tests was subsequently packed in iron oxide and annealed

TABLE II.—*The Influence of Different Degrees of Oxidation and Carbon Content on the "Blowing" of Iron-Carbon Alloys.*

Plate.	Treatment of plate.	Temperature of testing. Deg. C.	Degree of oxidation.	Volume of gas holes in brass disc. C.c.
Grey cast iron	machined	100	nil	0.17
		320	blue	0.29
		650	black	0.65
Mild steel 0.1 per cent. C.	machined	100	brown	0.01
		400	deep blue	0.01
		700	black	nil
High-carbon steel 1 per cent. C. ..	machined and ground..	100	nil	nil
		100	pale straw	0.04
		350	straw	0.10
		350	deep blue	0.20
White cast iron	as-cast	350	straw	0.09
		350	deep blue	0.14

at 950 deg. C. for 7 hrs. The surface layer after this treatment showed considerable decarburisation (see Fig. 4) and on re-testing gave only 0.03 c.c. of gas.

These results confirm the suggestion that "blowing" is due to a reaction between oxide and carbon in the surface layer of the ingot mould. Where the carbon content of the surface layer of the mould material was high, the amount of gas evolved varied, in each case, in the same direction as the degree of oxidation. In the case of mild steel, which gave a mere trace of gas at ordinary temperatures, the absence of "blowing" at 700 deg. C. was probably due to the thick layer of surface oxide. When for other reasons an ingot of the dimensions 12 in. × 6 in. × 1 in. was cast in a mild-steel mould at an initial temperature of 700 deg. C., the longer time of solidification permitted sufficient gas evolution at the steel-oxide face to cause some of the superficial oxide on the mould to be pressed into the ingot surface.

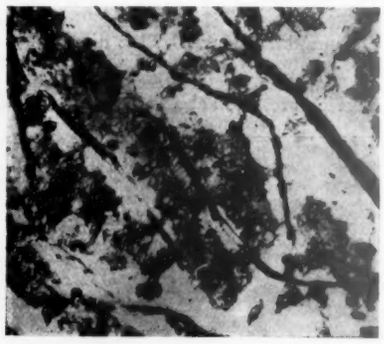

Fig. 6.—Centre of Grey-Iron Cylinder after Treatments *in vacuo*, showing Deposition of Graphite. × 250.

Temperature Necessary for the Surface Reaction.

In order to determine the reaction temperature between oxide and carbide, samples of grey and white iron were heated *in vacuo* after various treatments, and the volumes of gas evolved at different temperatures were measured. The specimen was heated in a silica tube in an electric furnace, with a thermocouple in contact with the specimen. The end of the tube was connected through drying towers and a mercury manometer to a vacuum pump. The specimen was inserted in the cold and the apparatus evacuated. Heating was then commenced and the volume of gas in the apparatus measured by the increase in pressure recorded. This gave the approximate volume, at room temperature, of the gas evolved, as the hot furnace tube comprised only a small proportion of the total volume of the apparatus.

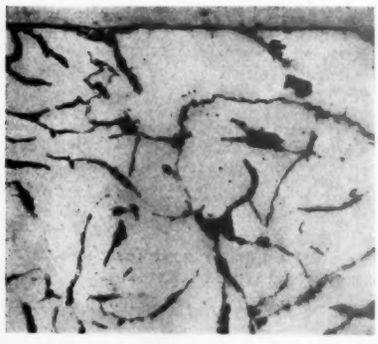

Fig. 7.—Edge of Cylinder shown in Fig. 6, showing Decarburisation of Pearlite. × 250.

Annealings of Grey Cast Iron.

Two cylinders each 4 in. long × 0.75 in. in diameter were cut from a 1-in. dia. sand-cast bar of grey iron containing:—G.C., 2.85; C.C., 0.55; Si, 2.25; Mn, 0.54; S, 0.01, and P, 0.02 per cent. The first cylinder, "A," in the "as machined" condition was heated to 880 deg. C. in 2.5 hrs. Evolution of gas commenced at 700 deg. C. and became rapid at 750 to 800 deg. C. After maintaining at 800 deg. C. for 2 hrs. evolution practically ceased, when 95 c.c. of gas had been evolved.

After several heats *in vacuo* a satisfactory blank was obtained. Removal of the specimen to a desiccator for several days resulted in the evolution of 48 c.c. of gas on reheating—again between 700 and 800 deg. C. Removal of the specimen from the tube and exposure to air for some hours was always followed by a gas evolution on reheating, while no gas was evolved after standing *in vacuo*. The specimen was then allowed to remain for some hours in the cold in the furnace tube in different gas atmospheres before reheating. Cylinder nitrogen (partially purified with alkaline pyrogallol) air and oxygen were tested in turn, each gas being dried. The volumes of gas evolved by the specimen after treatment are shown in Table III.

Fig. 8.—Structure of Non-Pearlitic Cast Iron. × 100.

Table III.—*Gas Evolved from Grey Cast-Iron Cylinder "A" on Annealing* in vacuo *after Various Treatments.*

Treatment of sample.	Gas evolved on annealing for 2 hrs. at 800 deg. C.
	C.c.
As-cast and machined	95
In vacuo for 18 hrs.	23
In air in desiccator for several days	48
In vacuo for 18 hrs.	2
In dry air in furnace tube for 48 hrs. in the cold	20
In vacuo for 18 hrs.	nil
In partially purified nitrogen in furnace tube for 19 hrs. in the cold	7
In dry air in furnace tube for 46 hrs. in the cold	18
In dry oxygen in furnace tube for 18 hrs. in the cold	20

The second cylinder, "B," from the same cast iron was subjected to similar treatments in different atmospheres. Purified nitrogen, air, and oxygen were in this case admitted when the cooling specimen was at 400 deg. C., and were left in contact with the cast iron for 18 hrs. in each case. The results obtained are shown in Table IV. It is apparent from these results that the "blowing" of grey cast iron which has been exposed to the atmosphere after the extraction of dissolved gases *in vacuo* is connected with the absorption of oxygen by the specimen. White-iron cylinders subjected to similar treatments gave off appreciable volumes of gas, again at 700 to 800 deg. C., only when oxidation between annealings was permitted.

Influence of Annealings *in vacuo* on the Structure and Composition of the Iron.

The original pearlite-graphite structure of the grey-iron bar "A" is shown in Fig. 5. After the various annealings *in vacuo* there was found to be a considerable deposition of graphite from the carbide throughout the bar, giving a structure in the central areas of graphite plus pearlite and ferrite (see Fig. 6). In the surface layers, however, no pearlite was visible, the structure being entirely ferrite plus graphite (see Fig. 7).

Table IV.—*Gas Evolved from Grey Cast-Iron Cylinder "B."*

Treatment of sample.	Gas evolved on annealing for 2 hrs. at 800 deg. C.
	C.c.
As-cast, machined and superficially oxidised	101
In vacuo for 18 hrs.	13
In air in desiccator for several days	51
In vacuo for 60 hrs.	10
In dry air in furnace tube at 400 deg. C. and for 18 hrs. in the cold	28
In pure nitrogen in furnace tube at 400 deg. C. and for 18 hrs. in the cold	6
In dry oxygen in furnace tube at 400 deg. C. and for 18 hrs. in the cold	51

Analysis of the bar after the treatment was carried out both on the surface layer from which 0.01 in. was turned and on drillings from the centre of the bar. Comparing these figures with the original analysis of the material, it is apparent that throughout the thickness of the bar an additional 0.15 per cent. of graphite had been deposited from the combined carbon. No diminution of total carbon had occurred in the centre of the bar, but the outer surface layer was decarburised by approximately 0.30 per cent. at the expense, apparently, of the combined carbon only.

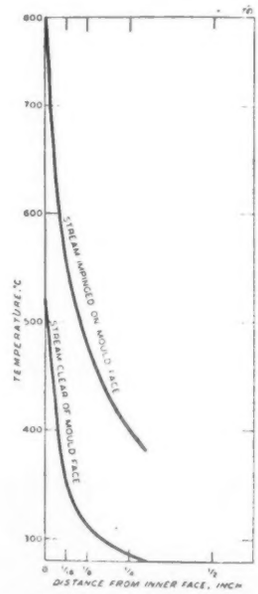

Fig. 9.—Maximum Temperature Gradient in Cast-Iron Mould Wall.

	Centre of bar.	Surface layer.
G.C., per cent.	3.01	2.99
C.C., per cent.	0.43	0.10

To supplement these results other cylinders from the same grey cast iron were annealed: (1) five heatings to 800 deg. C. under constant vaccum, and (2) five heatings to 800 deg. C. with intermediate oxidation. Micro-examination of the first of these bars showed some deposition of graphite from the carbide, and considerable residual pearlite, the structure being uniform throughout the section.

(*To be continued.*)

Fusion Welding as Related to Steel Castings.*

By T. S. Quinn.

For at least a quarter of a century, fusion welding, as distinguished from the old-time plastic welding, has been employed by the steel foundryman for repairing small defects in his product not sufficiently serious to warrant condemnation. The author believes it was during the early part of the twentieth century that fusion welding was first performed in the steel foundry by means of thermit. Arc welding by means of a motor-generator set, substantially as it is performed to-day, was introduced to the steel foundry about twenty-three years ago, in what is now one of the plants of the General Steel Castings Corporation. The author has been informed that the (American) General Electric Company, as the result of investigations made by Major R. A. Bull, then General Superintendent of the Commonwealth Steel Company, designed and supplied the concern last named with a motor-generator set, by means of which the plant voltage of 220 was reduced to 80, for providing resistance to produce fusion economically for the repair of steel castings.

It is only within the last fifteen years that fusion welding has come into prominence. Naturally the product of iron and steel foundries has been materially affected by the extended application of fusion welding to engineering structures. It is well-known that welded parts have superseded grey-iron castings for many industrial purposes, and it is a matter of common knowledge that weldings (a new, convenient term applied to structures formed by the fusion of connections) have had an important effect on the steel-casting industry. In some cases this influence has operated to the disadvantage of the individual steel foundry; in other instances the steel-casting shop has reaped direct advantages. In one respect the steel-casting industry as a whole has benefited greatly, through the stimulating example provided by designers of welded assemblages in emphasising the economic advantage of structural simplicity.

Not until the proponents of fusion welding realised and made clear to the industrial world the fallacy of invariable adherence to familiar forms of construction, did the welding industry begin to profit greatly. In this respect welders made a contribution to engineering which had not previously been made, either by founders or by those operating shops where riveting was the medium of assemblage. They realised that revision of design was essential for the economical employment of fusion fabrication as a substitute for riveted construction or for the integral casting, employed previously.

The Steel Founder's Attitude Misunderstood.

There has been confusion in the minds of some engineers regarding the attitude of steel foundrymen towards welding. This has been due partially to the natural excess of enthusiasm of certain manufacturers of welding equipment, who thought for a time that a marked reduction would take place in the tonnages of all kinds of ferrous castings required for industrial purposes. Economies resulting from the substitution of some weldings for castings prompted the thought that parts fabricated by the fusion of joints would ultimately take the place of castings to an extent that would materially lower the output of the steel foundry.

The average steel foundryman, in fact, for many years has zealously kept himself informed of the results secured by arc and gas welding, because of his employment of such welding for reclamation purposes. Moreover, the producer of steel castings, as the natural result of the characteristics of the metal he makes, is always ductility-conscious, and he, therefore, has taken pains to determine not only the tensile strength typical of the metal in welded joints, but the percentages of elongation and reduction of area which, combined, constitute an acceptable index of ductility. He has realised that a tensile strength of 85 per cent. of that in a casting made from common steel having a carbon content of say 0.28 per cent. might be fully satisfactory or definitely unsuitable for a given structural purpose, depending very largely on the amount of ductility in the welded connection.

With such considerations as these in mind, the conscientious steel foundryman has been unwilling to take a chance in welding a defect, if such salvaging involved an area of appreciable size in a member to be subjected to severe shock, or to frequent repetitions of serious stresses of any description. Those who make steel castings have not always been given credit for their desire, commercially inspired, to see the welding art developed to a point where, simultaneously good values for tensile strength and for ductility may be obtained regularly in routine welding.

In still another respect the foundryman's attitude toward welding has been misunderstood, namely, in his advocacy of heat-treatment for relief of internal strains induced by welding. It is well known that heat-treatment is desirable for eliminating the strains set up when steel solidifies. Evidence of such cooling strains is seen in the disconcerting behaviour of certain castings before full annealing or normalising to relieve these strains, which occasionally result in a rupture, accompanied by an explosive noise, of a large casting while subjected to external stresses of relatively insignificant degree. Since it is well known that the phenomena accompanying solidification of steel create these peculiar and sometimes disastrous internal strains, it is but natural that the steel foundryman, contemplating the welding repair of vital members in a casting intended for severe service, should have in mind continuously such security as may be attained by a simple form of heat-treatment. Arguments that have been advanced by foundrymen in favour of such treatment of welded-steel parts, for the relief of cooling strains, are properly founded on a knowledge of the behaviour of metals.

Efforts to Make Ductile Welds.

Fortunately, those who have directed intelligent efforts in the development of fusion welding by means of the arc and by the use of gas have made it practicable to obtain much more ductile welds than were ordinarily secured ten years ago. Placing great significance on ductility, the steel foundryman has had little interest in figures that have shown only a tensile strength in the welded joint comparable to, and sometimes superior to, that in some alloy grades of grey iron and in the grades of very soft carbon steel ordinarily used for structural purposes up to fifteen years ago. Since that time, there has been an increasing tendency to resort to higher carbon, manganese and silicon contents in carbon cast steels, resulting, when properly heat-treated, in higher strengths accompanied by outstanding ductility and economical machinability. Within the same period of fifteen years, as is well known, there have been notable advances in the development of alloy steels for cast and wrought parts, providing combinations of strength and ductility that are most impressive.

The steel foundryman has been cognisant of the principal difficulty facing those who have tried to develop equipment and procedure that would materially reduce or completely eliminate the injurious effects of oxidation. Exposure of the liquified steel to the atmosphere necessarily causes certain valuable elements present in the base metal and in the filler rods to oxidise to a varying extent. The oxidisable elements include carbon, manganese and silicon, which, in their combinations, tremendously influence physical behaviour.

Among the more recent developments, ingeniously devised for preventing this atmospheric contact, is the blanketing of the welding area by means of hydrogen gas, also used in the atomic-hydrogen method, employing the electric arc for generating heat.

An effort to prevent atmospheric contact with the liquid metal formed by fusion has been made in another important direction, involving the special coating of filler rods. Some of the material in the coatings previously used resolves itself into slag at the fusing temperature. When rods are of suitable chemical composition and when the welding operation is skilfully performed, the slag resulting from the rod coatings partially excludes the atmosphere. The difficulty inherently existing in connection with this type of coated rod is in the increased amount of slag formed, which is liable to be entrapped in the weld metal, especially if the weld is of appreciable depth. The most recent and one of the most promising developments to minimise deterioration of the weld metal from slag and from oxidation consists in coating the filler rods with material that creates a reducing atmosphere during the fusing operation. The objective is to provide a protecting blanket of a non-slagging nature. Experiments along these lines are being prosecuted, with encouraging results. These and other researches have been carried on by those welding experts who have realised that one cannot reasonably expect in weld metal those physical characteristics that provide adequate resistance to fatigue and impact, unless there is present in such metal, uncontaminated by gas or slag inclusions, the proportions of those chemical elements which, in combination, give steel its unique, invaluable, composite property we call toughness.

As the result of intelligent effort zealously applied, there has been attained a gratifying approach to those conditions of homogeneity, chemical composition and physical behaviour which characterise ordinary or carbon steel. This partial achievement has given the properly formed, average welded joint, whether made by means of gas or electricity, adequate resistance to withstand the stresses applied to such joints, in parts applied for a great many purposes.

No unfavourable criticism is implied in pointing out that discretion should be used in drawing conclusions on the dependability of the fusion-made joint. A steel foundryman who has published numerous articles on this subject has convincingly emphasised the fact that the nature, degree and direction of the stresses to be exerted in service should always be carefully considered by the construction engineer; and that the latter should inform himself regarding the physical behaviour of the weld metal in a connection selected as being representative.[1] For a great many purposes, such metal is entirely satisfactory. For many applications where certain stresses are applied with great severity and in directions that would be disadvantageous to the typical structure in weld metal, the fusion-made joint should be eliminated from consideration, and dependence should be placed on the integral piece of steel. Obviously, for a great many shapes, it is not feasible to provide such integral pieces of steel economically except by means of castings.

* A Paper presented to the Thirty-Fifth annual meeting of the American Society for Testing Materials. The author is Treasurer of the Lebanon Steel Foundry, Lebanon, Pa.

1 "Justifiable Uses of Welding," "Research Group News," October, 1927, page 148; "Fusion Welding Results Analysed," "Research Group News," April, 1931, page 375; "Uses of Steel Castings as Affected by Welding," "Metal Progress," February, 1931, page 70.

Design a Factor of Great Importance.

Mention has been made of the helpful example welders have given founders, in respect to design. In justice to those foundrymen who have not been indifferent about low-cost construction, it is but fair to state that arguments presented to some consumers of castings for the economical simplification of design were fruitless until very promising claims were made to these same consumers, regarding the savings possible with fusion welding, associated with the redesign of the part under consideration. The author believes that many economies resulting from welding fabrication have come about from the redesigning incidental to the decision to employ fusion for making certain connections, rather than from the new method of assemblage. Putting it differently, if the foundrymen had been permitted to simplify the design of the original casting so as to make it as cheaply as possible without sacrificing any desirable property or useful construction feature, the result obtained from the foundry would have been quite as satisfactory to the purchaser as the simple welded unit proved to be. It is human nature for the people generally to listen more attentively to claims made for the possibilities of a new process, than to the assertions regarding a well-known procedure. Novelty always excites interest.

Test Data.

The author presents the results obtained from a number of tests in welding cast steel by various methods. Some of these test data have been procured under the author's direction; others have been submitted to him specifically for his discretionary use in the Paper, by contributors who believe the information is accurate and based upon the best methods of various kinds in commercial use to-day.

Data Secured from Other Sources.

The author has no reason for discounting any of the data quoted. It is realised that, for certain purposes, these data would be more useful if they included statements making known the sources of information given the author. However, it has seemed that for the present purpose such information should be withheld, since discrimination made purely for the purpose of selecting what appeared to be accurate data had to be made, and since a contribution of this kind should not in any way advertise the equipment or supplies of proprietary nature now being merchandised by a large number of concerns. It is believed that the data will be self-explanatory within these limitations.

All details reported to the author regarding analyses, heat-treatment, etc., affecting the tests summarised have been included. In a few cases, averages only of groups of specimens have been stated, because the author did not have available the individual test data.

In summarising the data for presentation, the author has used fictitious heat and specimen numbers, employing a consecutive order simply for the convenience of the reader.

Tests of Cast Steel Welded by the Arc Method.

Report No. 1.

Bars Nos. 1 *to* 5.—Plates of plain carbon cast steel, 2 in. thick, having a carbon content of 0.30 to 0.35 per cent., were machined to form a double "V" of 45 deg. A current of 220 amperes was used. No peaning or hammering was done.

Bars Nos. 7 *to* 12.—Specimens welded under conditions similar to those existing when welding bars Nos. 1 to 6, except that larger electrodes and a current of 300 amperes with reversed polarity were used.

Tensile Tests on Welded Bars.

Annealed at 895 deg. C. after welding.

Nos. 1 to 6 averaged 26.7 tons per sq. in. tensile and 17.2 tons yield point, associated with 18.5 per cent. elongation on 2 in. and a 46.8 per cent. reduction of area. The corresponding averages for Nos. 7 to 12 were 25.7 tons tensile, 16.2 tons yield point, 13 per cent. elongation and 42.3 per cent. reduction of area.

Report No. 2.—Experiments were conducted in welding carbon cast steel with the arc in conjunction with a protecting envelope consisting of hydrogen and other gases, including 15 per cent. propane. Ordinary uncoated electrodes were used. This method is similar in some respects to the atomic hydrogen method. The average tensile tests on two welded bars, after annealing at 895 deg. C. subsequent to welding, were 37.8 tons per sq. in. tensile, 27.9 tons per sq. in. yield point, 21.0 per cent. elongation and 40.7 per cent. reduction of area.

Tests of Cast Steel Welded by the Oxy-Acetylene Method.

Report No. 3.—*Tensile Tests.* (Normalised 1 hr. at 895 deg. C., and tempered 1 hr. at 645 deg. C., containing C, 0.28; Mn, 0.71, and Si, 0.39 per cent.)

The unwelded bar (No. 15) broke at 33.0 tons tensile, associated with an 18.3-ton yield point, a 25 per cent. elongation and a 40 per cent. reduction of area. The welded bars (Nos. 16 to 18, Rod A) give 27.3 tons tensile, 16.7 tons yield point, 13 per cent. elongation and 36.5 per cent. reduction of area, whilst Nos. 19 to 21 (Rod B) averaged 26.1 tons tensile, 15.9 tons yield point, 15.8 per cent. elongation and 51.7 per cent. reduction of area.

Report No. 4.—*Tensile Tests.* The bars were normalised at 895 deg. C., heated 2 hrs., and analysed out at C, 0.35; Mn, 0.69; Si, 0.35; P, 0.033, and S, 0.040 per cent.

The two unwelded bars (Nos. 22 and 23) returned an average tensile strength of 39.2 tons per sq. in., associated with a 22.0-ton yield point and a 34 per cent. reduction of area. The average of the welded bars (Nos. 24 to 28) showed a strength of 34.2 tons tensile, a 20.5-ton yield point and 25.7 per cent. reduction of area.

Report No. 5.—Experiments were conducted on specimens from one heat of plain carbon cast steel to ascertain the effects of heat-treatment on the ductility of steel deposited in welding a given base metal by a given procedure. The results are shown in the figures for groups I, II and III.

Tension Tests on Welded Bars.

Group I.—Results on material as welded, without heat-treatment. Average of Nos. 29 to 31: 28.6 M.S., tons per sq. in.; 20.0 Y.P., tons per sq. in.; 15.0 R.A. per cent.

Group II.—Heated at 895 deg. C. for 1 hr. after welding, and cooled in air. Average of Nos. 32 to 34: 30.1 M.S., tons per sq. in.; 20.0 Y.P., tons per sq. in.; 27.3 R.A. per cent.

Group III.—After welding, bars slowly heated to 895 deg. C., cooled in air, reheated to 645 deg. C. for 1 hr. and cooled in furnace. Average of Nos. 35 to 40: 26.7 M.S., tons per sq. in.; 16.3 Y.P., tons per sq. in.; 44.1 R.A. per cent.

Report No. 6.—*Tensile Tests.* Normalised and tempered bars containing C, 0.35; Mn, 1.36; Si, 0.44; P, 0.035, and S, 0.039 per cent.

Two unwelded bars (Nos. 41 and 42) broke at 43.5 tons tensile, with 25.8 tons yield point and 39.7 per cent. reduction of area, whilst four welded bars (Nos. 43 to 46), which had been normalised and tempered after welding with rods containing approximately 0.40 per cent. C, 1.50 to 1.80 per cent. Mn and some Mo, averaged out at 43.3 tons tensile, 26.3 tons yield point and 32.3 per cent. reduction of area.

Report No. 7.—Five carbon-steel welded bars gave results which, when averaged, showed a yield point of 93 per cent., and a tensile strength of 87 per cent., of the properties in the unwelded material. The percentages of elongation in 2 in. ranged from 8 to 11, and the percentages of reduction of area ranged from 22 to 31 in the welded bars. These bars had been normalised at 870 deg. C. after welding.

Five medium manganese-steel welded bars gave results which, when averaged, showed a yield point of 120 per cent., and a tensile strength of 99 per cent., of the properties in the unwelded steel. The percentages of elongation ranged from 12.5 to 25, and the percentages of reduction of area ranged from 17 to 55 in the welded bars. These bars had been normalised at 840 deg. C. after welding.

Tests of Cast Steel Welded by the Atomic-Hydrogen Method.

Report No. 8.—Eight carbon-steel welded bars gave results which, when averaged, showed a yield point of 93 per cent., and a tensile strength of 81 per cent., of the properties in the unwelded material. The percentages of elongation ranged from 8 to 10 and the percentages of reduction of area ranged from 19 to 33 in the welded bars. These bars had been normalised at 870 deg. C. after welding.

Twelve medium manganese-steel welded bars gave results which, when averaged, showed a yield point of 96 per cent., and a tensile strength of 88 per cent., of the properties in the unwelded material. The percentages of elongation ranged from 5.5 to 16, and the percentages of reduction of area ranged from 16 to 55 in the welded bars. These bars had been normalised at 815 deg. C. after welding.

Report No. 9.—*Tensile Tests on Welded Bars.* Normalised 40 min. at 895 deg. C. and tempered 1 hr. at 690 deg. C., after welding with rod from steel made of the following chemical composition: C, 0.27; Mn, 0.73, and Si, 0.42 per cent. The average figures returned by four bars (Nos. 47 to 50) were 27.4 tons tensile, 17.3 tons yield point, 23.7 per cent. elongation and 57.5 per cent. reduction of area.

Report No. 10.—*Tensile Tests.* Normalised at 870 deg. C., heated 2 hrs., made from the following chemical composition: C, 0.35; Mn, 0.69; Si, 0.347; P, 0.033, and S, 0.040 per cent.

Two unwelded bars (Nos. 51 and 52) yielded the following average tests: Maximum stress, 39.2 tons per sq. in.; yield point, 22.0 tons per sq. in.; elongation on 2 in., 25 per cent, and reduction of area, 34 per cent. Eight welded bars (Nos. 53 to 60) were tested after welding with a rod containing 0.18 per cent. C, 1.40 per cent. Mn and 0.50 per cent. Si, and furnished the following average figures: Tensile, 31.6 tons; yield point, 20.9 tons; elongation, 9.6 per cent., and reduction of area, 25.8 per cent.

Report No. 11. *Tensile Tests.*—Chemical composition: C 0.355; Mn 1.40; Si 0.47; P 0.035, and S 0.039 per cent. Two unwelded bars (Nos. 61 and 62) were first normalised at 915 deg. C., tempered at 260 deg. C. for 12 hrs. and on pulling gave 44.5 tons tensile, 26.8 tons yield point, 28 per cent. elongation and 56.6 per cent. reduction of area. Eight welded bars (Nos. 63 to 70) were normalised 915 deg. C. and tempered at 260 deg. C. before welding, and then normalised at 770 deg. C. after welding. The welding rod contained C 0.25, Mn 1.50, 0.40 Si and 0.40 Mo. On testing, the following averages were returned:—39.2 tons tensile, 26.3 tons yield point, 10.1 per cent. elongation and 25.1 per cent. reduction of area.

To ascertain the influence of a heat-treatment on the welded material which has the effect of "aging" on unwelded steel, four additional bars, welded by the atomic-hydrogen method, with rod material of the composition used for bars Nos. 53 to 60, were heated, after welding, at 770 deg. C., machined, and tempered at 260 deg. C. for 12 hrs. Four bars (Nos. 71-74) returned the following averages:—38.3 tons tensile, 24.5 tons yield point, 13.3 per cent. elongation and 41.4 per cent. reduction of area.

Report No. 12. *Tensile Tests on Welded Bars.*—Annealed at 895 deg. C. after welding and made from C 0.32, Mn 1.25, Si 0.32, Mo 0.33, P 0.033 and S 0.007 per cent. The average of five bars (Nos. 75 to 79) gave 35.6 tons tensile, 20.1 tons yield point, 20 per cent. elongation and 47.2 per cent. reduction of area.

(*Continued on page* 164.)

An Engineer's Review of the Soviet Enterprise.

THE FIVE-YEAR PLAN.

Mr. A. P. M. Fleming, in a Paper entitled "An Engineer's Review of the Soviet Enterprise," read before Section G (Engineering) of the British Association at York, remarked that the suggestion made by the President that the abilities of those who are engineeringly-minded and experienced in engineering affairs should be utilised in the solution of the difficulties with which the greater part of the world is faced had led him to think that the occasion was opportune to survey the principal features of the Soviet enterprise in the well-known Five-Year Plan and the forthcoming second Five-Year Plan. It was not his intention to consider in any way the U.S.S.R. political plans as they affected the rest of the world but, from the point of view of an engineer, to survey those aspects of the enterprise which were noteworthy to a consideration of the ways and means of dealing with the economic problems now confronting the rest of the world in the hope that they might suggest some means whereby the experience gained in this great Russian experiment could be utilised for the achievement of the same objective, but under the entirely different conditions which apply in capitalist countries.

The speaker reminded his audience that Russia occupies one-sixth of the land area of the globe and contains 147 million people of 200 nationalities. The natural resources, with the exception of rubber, were all that were required by modern civilisation. Climatic conditions were, in places, of the severest, and subject to the greatest extremes, with the corresponding effect on the possible working periods. Road and rail transport was largely limited to the principal existing industrial centres, and there was very little ice-free seaboard. Until the last decade 80 per cent. of the population were illiterate and almost entirely unskilled as regards the manufacturing industries. The result of the revolution was to place in authority a group of leaders determined to make the U.S.S.R. economically self-contained by the development of the great wealth of natural resources and, in a comparatively short period of time, to raise the standard of living to not less than that of other countries. To achieve this aim the standard of living of the present generation, it was recognised, must be very low. Some 50 per cent. of the national income was being withdrawn from consumption and used to finance new productive State enterprise—all private interests being suppressed. In contrast to capitalist countries, girls and boys were trained, and men and women worked, side by side on the same jobs in every type of labour, and up to the present there was great enthusiasm for the scheme on the part of the people. Whether that would remain and continue, however, when the general position of the country became easier, was a matter that time alone could decide. One reason at the moment for this enthusiasm, probably, was the fact that the bulk of the population had no free contact with other countries.

Main Feature of U.S.S.R. National Economy.

The main feature of the U.S.S.R. national economy was the planning of both production and trade under a single system. This planning had been concentrated in the State Planning Commission, and the Supreme Economic Council was the special controlling Commissariat responsible to the State Planning Commission for regulating, supervising and administering industry and the trades directly concerned with it, and is responsible for carrying out the much-discussed Five-Year Plans. During the present year the Supreme Economic Council had been reorganised into three groups dealing respectively with the heavy industries, the light industries, and the wood and timber industries. These groups were again subdivided into separate sections, one dealing with generation and transmission of power, another with supply apparatus, etc. Manufacturing is entirely in the hands of the State Combines, which report to the appropriate section of the Supreme Economic Council. In short, the industrial position in Russia now is that there is only one producer and one customer—the State, so that all questions of expense of selling, profit-taking at various stages between the raw-material producer and the production of the finished article, and profits to the consumer, are cut out, as also are profits on transport. Thus, in producing fabricated articles, chief attention can be directed to their economic production, and without the need for a high degree of finish or such additions to finish as may represent selling-points under a competitive system. Production can be on definitely standardised lines, again resulting in considerable economy in the first cost of production.

The Labour Position.

In general, labour was not very efficient. For mass production the unskilled labour could quickly be trained to the necessary degree of efficiency, but where manufacture requires individual skill and effort, as in the case of steam turbines and the bulk of electrical machinery, the output per worker is probably of the order of 50 per cent. of Great Britain or America, and probably some castings, for example, would be rejected in this country on appearance alone.

Generally speaking, Russia is on a war footing, *i.e.*, the standard of living being at the lowest level of subsistence practicable, while all possible resources are being used to build up the productive facilities. There are about 12 million industrial workers as compared with two million in pre-war days, and factories employ as far as possible not less than 50 per cent. of women, and in some cases 60 per cent.

Most of the weaknesses that visits to Russia disclose, said Mr. Fleming, are remediable. For example, the tremendous expansion of industry inevitably introduced much inefficiency of working, and there were some questionable features of quality which may react under service conditions. There is a lack of suitable men of the non-commissioned officer type in industry, but this and other matters would, no doubt, be remedied in time. At present the factories work seven hours a day and office workers about six hours, four days out of five being working days.

The Five-Year Plan.

The First Five-Year Plan aimed at raising the economic status of the country by the rapid development in the first place of the heavy industries, and particularly the electrical industries. The year 1931 witnessed the completion of the first phase of the process of electrifying the Soviet Union. The output of the electric power stations was 7,700 million units, which it is estimated to increase to 12,500 million units in the present year, and this increase will be made possible because the total capacity of the stations will be augmented by 1,500,000 kw. The two main objects of the 1932 developments are, firstly, hydro-electric stations which will be used largely for the metallurgical industries, and, secondly, the construction of central electric heating stations. Electricity is the fundamental basis of the development visualised under the Second Five-Year Plan, and the success of the plan is dependent on the creation of a modern power base founded on the electrification of transport and industry and the application of electric power to agriculture. Thus, it is hoped that by the end of 1937 an output of 100,000 million units will have been reached.

Among the other proposals of the Second Five-Year Plan are (1) the construction of 30,000 km. of new railways and several scores of bridges; (2) an increase in the yearly output of coal to 250,000,000 tons; (3) an increase in the output of pig-iron to 22,000,000 tons; (4) to increase the output of the machine-building industries 3½ times; (5) an increase in the output of all by 2½ times. New and more powerful locomotives are to be introduced, larger goods trucks, several railway lines are to be electrified, the mercantile marine is to be reconstructed and ports extensively improved, new roads are to be built, air lines still further improved, wireless communication extended and the production of non-ferrous metals is to be so developed as to supply the home needs in copper, lead, zinc, aluminium and the rare metals. The development of the chemical industry is to aim primarily at increasing the output of fertilisers and basic chemicals.

The Dnieper Combine in the Ukraine.

Mr. Fleming gave some details of the Dnieper Combine in the Ukraine as a typical example of what is being done and what is to be still further developed under the Five-Years Plans. A "Combine" is primarily located at some large inexpensively exploited source of power in the vicinity of mineral wealth and good agricultural soil, involving the migration and settlement of a vast population of industrial and agricultural workers. In the case of the Dnieper scheme, the nearest point of consumption of the electric power produced there is the important coalfield of Donbass, 150 miles away, and it is proposed to utilise the main bulk of the output at a new city which is being built near the dam. The output is estimated in a dry year at 2,500 million units and in a wet year at 4,410 million units. The Dnieper Combine consists of nine units to be established round the power stations and will cover an area of 14 sq. miles. These nine units are the Dnieper River waterway; the hydro-electric station; coke and by-product plant; metallurgical plant; ferro-alloys plant; aluminium plant; firebrick yards; plants' slag cement products, and machine-repair plant.

Rich deposits of manganese, coal, iron, etc., exist in the vicinity of the works. The coke and by-product plant has been included in the Combine in order to economise in the transportation of coke and to allow for the utilisation of the gas produced by the coke ovens in heating the furnaces. The annual capacity of the plant has been set at 1,130,000 tons of metallurgical coke and about 100,000 tons of smaller-sized coke, the plant consisting of four batteries of 69 ovens each with by-product plant.

The steel plant will specialise in high-grade steel, and the annual output is estimated at 1,250,000 tons. The ferro-alloy plant will have an annual output of 80,000 tons of ferro-manganese, 20,000 tons of ferro-silicon, 4,000 tons of ferro-chromium and 1,600 tons of ferro-tungsten. The aluminium works will have an annual capacity of 20,000 tons and consist of an oxide plant, an electrolytic plant and the electrode plant. In producing annually 1,800,000 tons of pig-iron, the blast furnaces will yield during the same period up to 1,000,000 tons of granulated slag for the manufacture of cement and slag bricks. The annual capacity of the various enterprises is put as follows:—Slag cement 2,600,000 barrels, 30,000,000 bricks, 20,000 tons of lime and 150,000 tons of firebricks.

The tendency during the past few years, concluded the author, had been to view the Soviet enterprise much in the light of what each individual thinker hoped might happen to it and for the most part hopes had been centred on its failure. It would, however, be more rational to adopt the view that this great experiment is worthy of the closest study, and just as in the solution of their great problems the Soviet has examined critically and utilised fully the experience and personnel of other countries, so also those of other industrial countries might well profit from the success and failures of the U.S.S.R. in the solution of the problems, national and international, that beset us.

XUM

The Stein Suspended Furnace Roof.

CONSTRUCTION THAT FACILITATES REPAIRS.

During recent years it has become almost general practice to adopt the suspended form of roof in connection with the construction of large combustion chambers for water-tube boilers. The application of the suspended roof to metallurgical furnaces is also on the increase; indeed, this is often the only method of construction which will permit the large furnace to function correctly.

There are, of course, several various designs of suspended roof upon the market, and it may not be out of place if we briefly consider the essentials of an efficient suspended roof. First and foremost the construction must be strong and of a form not subjected to local concentration of stress. The component blocks should float freely to avoid stress due to expansion. The main carrying structure must be well away from the crown to avoid possible overheating, and the hangers should be air-cooled to prevent overheating when the blocks burn back. Individual blocks should be removable with a minimum of disturbance of other work, whilst it should be practical to adjust the contour of the roof without major structural alteration. Provision should also be made for efficient insulation without risk of overheating any of the metallic parts. With many types of high-temperature furnaces it is not desirable to use such insulation, as the blocks would be too rapidly burnt back and the fuel economy be more than negatived by block renewal costs; for furnaces operating at moderate and low temperatures, insulation of the walls and crown will affect a considerable saving in fuel.

Given the above requirements with the suspended roof, the uniform heat distribution over the whole furnace hearth is more readily obtainable than with the sprung arch, with which last, for constructional reasons, far greater space has often to be allowed between the underside of the roof and the furnace hearth than is required for the correct flame and gas flow, an arrangement which is not only directly wasteful but is frequently responsible for excessive scaling.

Referring to Fig. 1, it will be seen that in the Stein construction each alternate block is supported by a round steel pin, passing through a hole which is formed through the centre of the block towards its upper extremity, a form of construction which entirely eliminates local stresses. Where the supporting members project into the refractory blocks, local strains are set up in the refractory material immediately surrounding. The blocks themselves, in order to facilitate kilning, are made in halves, the maximum thickness not exceeding 4¾ in. The halves are then cemented together with a cold-setting high-temperature cement. It will also be noted from Fig. 1 that the blocks have complete freedom of movement.

In Fig. 2 we illustrate the method of construction used for nosings. It will be noted that the construction is similar to that used for flat roofs and only one face of the blocks is exposed to the heat, spalling and burning away is thus reduced to a minimum. Providing the underside of the blocks have not become fused together, any individual block can be easily replaced, the intermediate blocks being withdrawn from above. In order to replace one of the directly-supported blocks, the intermediate blocks on either side are first withdrawn, the suspended block is then slightly raised and the supporting circular pin is free to be withdrawn. Until the block is raised the circular pin is locked in position.

If at any time it is desired to alter the height or contour of the arch, this can be done by a simple adjustment of the nuts on the upper ends of the vertical supporting rods.

The Stein suspended roof has been designed with a view to simplify insulation, where that is desirable, by using standard insulating slabs or insulating powder. Our illustration (Fig. 1) clearly shows that there is no risk of overheating any of the metallic supports, as would be the case were the insulation carried outside them.

We are indebted to Messrs. Stein & Atkinson, Limited, London, the builders of the roof described, for the particulars upon which the description is based.

FIG. 1.—GENERAL VIEW OF THE STEIN SUSPENDED FURNACE ROOF CONSTRUCTION.

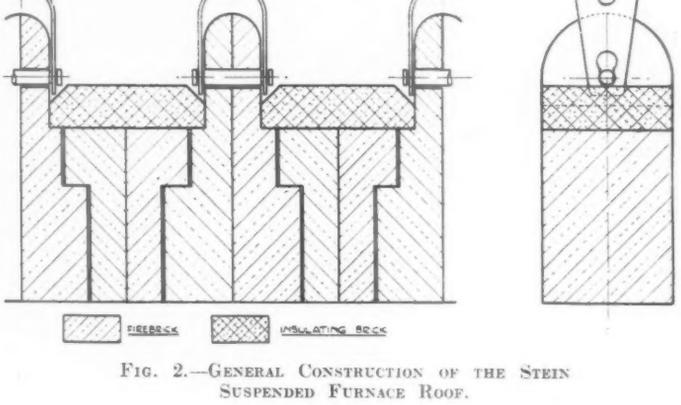

FIG. 2.—GENERAL CONSTRUCTION OF THE STEIN SUSPENDED FURNACE ROOF.

Chelsea School of Metallurgy.—Students will be enrolled on September 19 and 20. A prospectus giving particulars of the courses in metallurgy and assaying (including engineering metallurgy) may be obtained from Mr. W. A. Nash at the School, Manresa Road, London, S.W.3.

Precipitation Hardening of Fe-Co-W and Fe-Co-Mo Alloys.

In a communication from the Research Laboratory of the United Steel Works Company, Dortmund, published in a recent issue of "Archiv für das Eisenhüttenwesen," W. KÖSTER gave the results of an investigation of iron-cobalt alloys with varying additions of tungsten and of molybdenum. It was found that the variation of the hardness with the tempering temperature differed according as the initial structure of the alloy was ferritic, austenitic or martensitic. By following the change in the specific weight, the electrical conductivity and the magnetic saturation it was established that the process of tempering in the case of the ferritic and austenitic alloys depended only on the separation from the solid solutions of the series Fe_3W_2-CoW or Fe_3Mo_2-CoMo respectively of the excess dissolved in them; with the martensitic alloys there was in addition the transformation of the residual austenite, which commenced at a lower temperature than the separation. The hardening of the ferritic alloys is accelerated if the supersaturated α-solid solution is produced by quenching from the γ-state. The hardness numbers for all three types of structure rise as the contents of cobalt and tungsten or of cobalt and molybdenum are increased. Hardness up to 70 Rockwell C units was obtained.

The magnetic hardening of the α-alloys produced by the separation takes place at temperatures only slightly higher than the mechanical hardening. The widening of the hysteresis loop assumes considerable values. In the extreme case an increase in the coercive force to 75 times that in the quenched state was observed. The coercive force was in this case 350, the remanence being 7,300. The coercive force increases as the contents of tungsten or molybdenum and cobalt are raised. The remanence decreases as the content of tungsten or molybdenum is raised but increases as the content of cobalt is raised.

The precipitation-hardened martensitic alloys are suitable for cutting tools, the ferritic alloys for permanent magnets. The metallographic basis of the carbon-free alloys, which differs fundamentally from that of the alloyed carbon steels which have hitherto been employed, in combination with their special properties presents new possibilities for the production and use of cutting tools and of permanent magnets.

Efficient Casting Design.

By F. C. Edwards

Metal castings are proverbially easy to produce. Indeed—given the mould and the molten metal—castings produce themselves. When our observant ancestor discovered this fact he was probably so elated with his good fortune that he made an offering to the gods. In speed of formation, too, castings, excel. It takes but a few seconds for the average casting to grow completely to its predestined stature, and the leviathan of many tons builds itself up, from "keel to mast-head," in a few minutes.

This autogenous quality of castings, however (as the ancient artificer would soon discover), has, as its price, an advanced order of technique. Forging metal objects is a "direct" process: work is done on the actual component. Similarly with "built-up" structures, before assembly, the individual and collective fitness of the various sections can be tested, and adjustments, if necessary, made to secure the desired whole. Casting production, on the other hand,

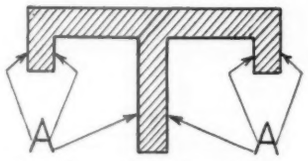

Fig. 1.—A Flat-Top Casting Design.

is an "indirect" process. The founder "shapes the casting" *through the instrumentality of the mould.* He cannot directly test any section of the casting until it is too late to make adjustments. The actual test is applied by the molten metal—and with this there is no compromise! If a casting is to be produced, the molten metal must meet its "affinity" in the mould. Such mould affinity, moreover, is not confined to composition, refractoriness, etc., neither is it attained by the acme of perfection in the art of moulding. The founder's ability must exceed his art. He can only bridge the gap between cause and effect by reasoning from experience. He must employ science. And the particular science which gives

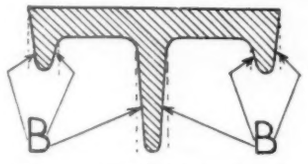

Fig. 2.—A Design similar to Fig. 1, but Improvement.

the key to that mould affinity necessary for efficient casting production is the science which treats of shape as related to moulding and molten-metal requirements.

Correct Mould Shape.

Correct mould shape is of treble importance. Herein lies the peculiarity of casting design. Its concern is not solely with the ultimate purpose of the casting, but also, and vitally, with molten metal and the mould which carries the design into execution. The design determines the mould; the mould—if the design, say, accommodates shrinkage stress—produces the casting. If the design accommodates shrinkage stress! The apodosis is vital, for, if the design fails in this respect, the mould produces scrap! This means that however accurately the load which the component is required to carry is calculated and allowed for, and however generous the "safety factor" employed, unless the effects of shrinkage are taken into account, the casting may fail in service—even if it does not fall to pieces in the mould under its own cooling stresses. The expert foundryman, admittedly, has various correctives at his command for combating shrinkage stress, along with an uncanny flair for their successful application, but it is the draughtsman's business to anticipate this bugbear of casting production whilst the job is on the drawing board. His special glory consists in viewing scrap prophetically—not historically.

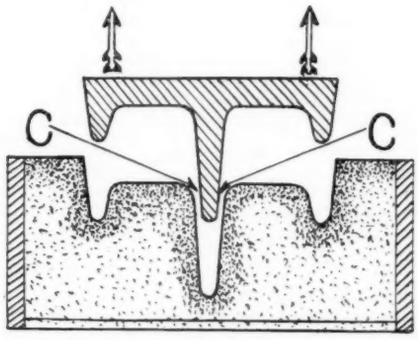

Fig. 3.—Showing how the Design in Fig. 2 Strips.

Now it is extremely desirable, at the outset, that the draughtsman who is accustomed to designing non-cast structures—say, of wood or mild steel—in order efficiently to design castings, should adopt "a new way of thinking." That this is a vital preliminary is shown by a moment's consideration of the evolution of

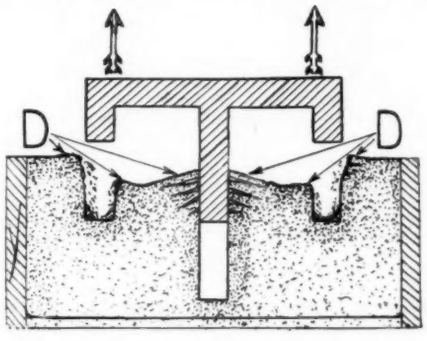

Fig. 4.—The Poor Stripping Quality of the Design shown in Fig. 1.

design in general. One invariably finds that in the employment of new material the old designs—*i.e.*, those dealing with the earlier (and, maybe, fundamentally different) material—persist and prejudicially retard the establishment of the new material. The most glaring example, perhaps, in which existing design was "carried forward" into a new set of conditions is that of the motor car. The designers of the earlier models blindly (and quite naturally) maintained the external form of the horse-drawn vehicles. Redundant features (viewed, that is, in the light of subsequent automobile evolution) were allowed to remain, and improvements in design, rendered possible—indeed, desirable—by the new method of propulsion were generally ignored.

Continuity of Bad Design.

Casting design similarly labours under this historic impediment. It is by no means uncommon to find castings designed in a manner that would be quite satisfactory if they were composed, say, of wood. Adjoining members with sharp, re-entrant angles remind one of framed-up woodwork, and comparatively light sections of metal in close contiguity with heavy sections resemble thin panelling attached to hefty beams. These incongruities (from a casting point of view) are even met with in combination. Such cases may truly be regarded as the foundryman's *bête noire*: try as he may, he cannot ensure a sound casting under these circumstances.

Then there is the mould to consider. The cost of moulding—and, incidentally, the percentage of scrap—is generally proportionate to the intricacy of the design. Here simplicity pays. No casting design can be really efficient, indeed, which does not reduce the operation of moulding to the simplest possible terms (consistent, of course, with the ultimate requirements of the casting). From this point of view, the 100 per cent. efficient casting design is more or less a rarity. The reason is not far

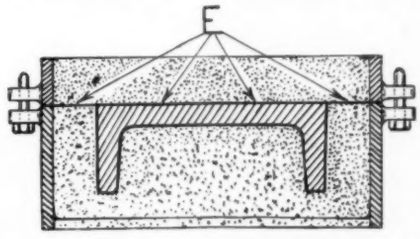

Fig. 5.—Compared with Fig. 6 shows the Superiority of the Flat-Top Design.

to seek. In the first place, the average engineering drawing office seldom appreciates the far-reaching effects of good or bad moulding design, respectively, upon quality and quantity of output. Secondly, the foundry is, notoriously, too prone to accept, and to make the best of, any design it may be called upon to execute. Such acquiescence—though laudable enough in itself—tends, inevitably, to perpetuate bad design. Whatever *has been done*, naturally argues the draughtsman, can be done again—with varia-

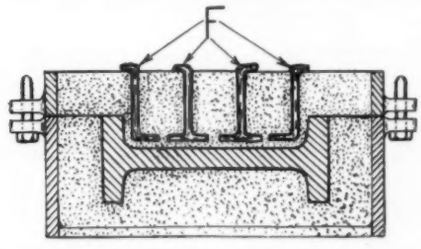

Fig. 6 shows how Lifters or Grids may be Required in such Designs.

tions! Quite true; but what of the cost? Why not seek the path of least resistance for the moulder? Why not eliminate production snags, and increase output? With repetition work, indeed, the cumulate effect of so-called minor hindrances to production, attributable to faulty design, may easily convert a potential profit into a definite loss.

What the Designer Should Appreciate.

To anticipate moulding snags whilst the job is on the drawing board implies the visualisation of moulding operations. These—with what is known in the foundry as an ordinary "two-part" job (of which an example is seen in Fig. 5)—may be briefly summarised as follows:—(1) The pattern is placed, flat side down, on the joint surface of the cope (*i.e.*, the top-part moulding box), which has been temporarily filled with sand; (2) the drag (*i.e.*, the bottom-part moulding box) is placed over the pattern,

around which sand is rammed until the box is filled; (3) the whole is turned over, the temporarily-filled cope is removed, the joint is made and dusted with parting sand; (4) the cope is replaced and rammed up, and provision is made for the subsequent introduction of the metal; (5) The cope is removed, the patten rapped and withdrawn from the mould; (6) the mould is repaired, if necessary, and dry-sand cores, if any, inserted, and (7) the cope is finally replaced, the pouring gate is arranged, and the mould is weighted and ready for the reception of the molten metal.

In the foregoing operations, the draughtsman is principally concerned with the formation of the mould joint and the withdrawal of the pattern. Having determined, from service requirements, the general contour of the component, he should arrange the details of the design to secure the simplest possible mould

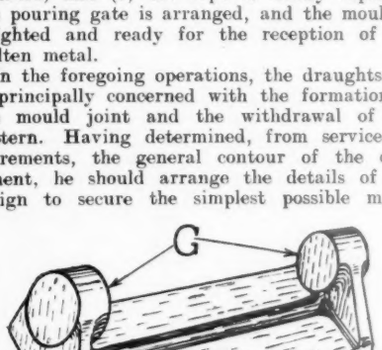

Fig. 7 shows a Bracket of Common Design.

joint, or joints, as well as to facilitate the withdrawal of the pattern. The ideal mould joint nowhere deviates from the horizontal plane. An absence of upper projections on the pattern is also desirable. This gives the simplest form of joint—the "flat top-part." A generous taper in the direction of pattern withdrawal (wherever the nature of the component renders this permissible) is another hall-mark of efficiency in casting design. Not only is such taper of tangible assistance to the moulder, but it promotes accuracy in the component by obviating mould disturbance during the withdrawal of the pattern. Consistent taper, again, in conjunction with ample corner fillets, usually confers on the casting an enhanced esthetic value.

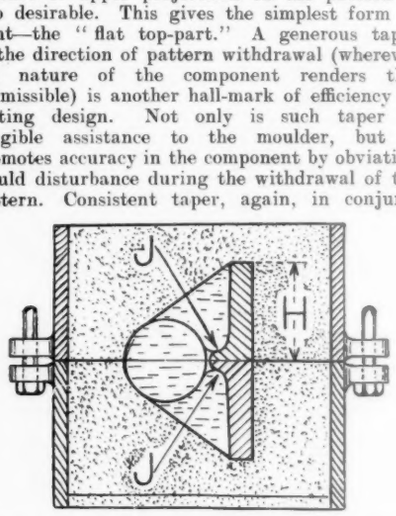

Fig. 8.—A Poor Method of Moulding the Bracket shown in Fig. 6.

Flat Top-Parts.

Elementary examples of "flat top-part" design, with comparative moulding features, are shown in Figs. 1 and 2. It will be noted that the vertical sides, A, Fig. 1, are square—*i.e.*, they are at right angles with the top surface—whilst the corresponding sides, B, Fig. 2, are tapered. As the lines, B, fall away from the vertical, they render the design seen in Fig. 2 a proportionately superior moulding proposition compared with that of Fig. 1. This superiority will be evident by a comparison of Figs. 3 and 4. In each case, the patterns are shown partly withdrawn (in the direction of the arrows) from their respective moulds. Taper clearance between the pattern and the sides of the mould is shown at C, Fig. 3. This clearance increases, of course, as the pattern is withdrawn. Though the pattern may not be withdrawn quite vertically, the mould, in this case, remains undisturbed. When taper on this type of pattern is "conspicuous by its absence," however, the mould (or, rather, what is left of it) is apt to undergo a decided upheaval—or multitude of upheavals—as shown in Fig. 4. In this case the slightest deviation from the strict, vertical lift produces a result on the mould similar to that seen at D. The extra pressure on one side or the other, plus the upward movement of the pattern, overcomes the cohesiveness of the mould. This, of course, adds materially to the subsequent work of "finishing." It also increases the risk of scrap. For, however skilfully the repair may be carried out, "scabbing" may occur. The fissured strata lend itself to displacement. Disturbed portions are apt to break away. When this happens, the casting is not merely found with uncalled-for protuberances (these can usually be removed), but the detached portions of sand float upwards, and register themselves on the castings as unsightly holes—which are not shown on the blue-print!

Ribbed and Flanged Plate Castings.

Where plate, or similar, castings require flanges or ribs, the best moulding design is that in which the flanges are arranged on one surface only. The ideal flat-top joint is thereby secured. A comparison of Figs. 5 and 6 will make this point clear. The patterns are shown in position, as moulded. Fig. 5 illustrates the desired flat-top joint, E. In Fig. 6, on the other hand, the top-part mould extends below the box joint. This means that extra provision—*i.e.*, compared with the job shown in Fig. 5—must be made to carry the projecting

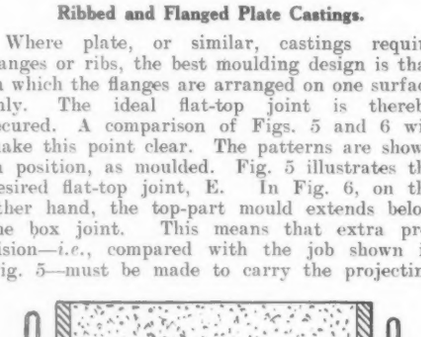

Fig. 9 shows how by Using the Flat-Top Principle Moulding is Facilitated.

portion of the mould. The moulder then has to employ either "lifters"—F—or specially-made grids (not shown in the sketch). These are coated with clay wash and rammed up in the mould, with about ½ in. of sand separating them from the pattern. The upper ends of the "lifters" are hooked over the box bars, as shown in the sketch. When grids are employed, they are suspended by means of wrought-iron rods cast in convenient positions. The upper ends of the rods are formed into "eyes" through which other rods are subsequently passed. These take their bearing on the top of the box bars. Such, in brief outline, is the extra work entailed by deviating from the "flat-top" design.

Figs. 7, 8 and 9 illustrate how a slight change in design may secure the "flat-top" joint. Fig. 7 shows a bracket of a fairly common type. Bosses, G, to carry a shaft, are required at each end. If we leave out of the question the employment of dry-sand cores (which is bad practice, and involves core-making), such a pattern would be moulded as seen in Fig. 8.

Mass and Porosity.

It will be noted that half the pattern extends into the cope. This necessitates a cope sufficiently deep to accommodate the height, H, projecting above the joint. The withdrawal of the pattern might also lead to a damaged mould. Incidentally, in cases where the close proximity of the boss to the plate reduces the width of the mould at J below, say, ¼ in., there is the added danger of displacement of portions of the mould by the molten metal. And, as previously mentioned, wherever such displaced portions finally come to rest, a corresponding hole will be found in the casting. There is the further well-established fact, that such fine projections of sand close to comparatively heavy masses of metal generate gases which, finding their way into the casting, become entrapped, and thus give rise to porosity.

By carrying the boss down to the plate, however, as shown at K, Fig. 9, the ideal flat joint is obtained. This means that an ordinary cope may be used for covering the job. With the bosses cast downwards again, the soundest metal would gravitate to where its presence was most essential. The shallow outside facings would, of course, be made circular, and loosely wired or "dovetailed" in position. The internal D-shape bosses, K, would provide ample space for the removal of the facings after the pattern had been withdrawn.

The difference in the labour required for fettling castings of the "flat-top" design should also be noted. This may easily amount to a 50 per cent. reduction in fettling cost. Further, loosely-fitting moulding-box pins (not uncommonly met with in the ordinary foundry) may lead to rejects in the case of such joints as that seen in Fig. 8, on account of "crossed joints" in the casting. Moulded as shown in Fig. 9, however, so long as the cope is down on the drag, it matters not how it is oriented.

Swedish Economic Conditions.

The visit which the Prince of Wales and Prince George are to pay to Sweden next month as the guests of the King gives special interest to the Report on Economic Conditions in Sweden by the Commercial Counsellor at the British Legation in Stockholm, which has just been issued by the Department of Overseas Trade.

Sweden, says the Report, in a note on marketing methods, is an attractive and interesting market, as, generally, credit is good and trading conditions fairly sound, *i.e.*, the Swedish trader is as a rule both efficient and honest; he is receptive of new ideas, anxious to be up to date, and usually prepared to pay for quality; the individual purchasing power is high.

German and American competition is very keen, the former country being favoured by proximity, good communications, and long-standing, intimate ties and connections in blood, history, language, culture, technical training and trade.

The United Kingdom trader has also to overcome the belief common in Sweden that Englishmen are slow to meet special requirements and are unaccommodating; that in many lines their packing methods are uneconomic, and that their weights, measures, money, and methods of stating, setting-out, and counting quantities and prices are troublesome.

The Report is a mine of British information for the British manufacturer, and as considerable attention is likely to be directed towards Sweden and things Swedish as a result of the Princes' visit there next month, it will well repay examination and study. As the Report recalls, English is spoken by members of most business firms, and "as a rule intending visitors need not anticipate difficulties on account of language."

Finally, it records that while it is possible that in solving its present problems Sweden may be obliged to decrease its consumption of imported goods, "it is scarcely possible to imagine that the cultural standards of the country will be so affected that it will not remain an important market for the high-class articles which it obtains from Great Britain."

This Week's News in Brief.

Trade Talk.

MESSRS. GJERS, MILLS & COMPANY, LIMITED, are now only blowing in two blast furnaces at their Ayresome Ironworks, Middlesbrough. The works have been closed for a lengthy period.

FOUNDRIES making machinery for soap production will learn with interest that Messrs. Thomas Hedley & Company, Limited, of Newcastle-upon-Tyne, are constructing a new factory on a 10-acre site at Trafford Park, Manchester.

THE DEPARTMENT OF COMMERCIAL PRODUCTS of the City of London College has arranged for a course of 25 lectures on iron and steel, to be given by Mr. T. Barton Kelly, on Thursdays, from 6 to 7 p.m., commencing September 22.

AUGUST'S, LIMITED, of Thorn Tree Works, Halifax, have received a contract from Messrs. Ruston & Hornsby, Limited, of Lincoln, for the installation in their Spike Island foundry of one of their complete sand-preparing plants.

RECENT EXPERIMENTS with 90-ft. rails are stated to have proved satisfactory. The London & North Eastern Railway has laid a short length of track with rails of this length, and tests are also being carried out by the London Underground Railways.

MESSRS. WILLIAM DENNY & BROS., LIMITED, Leven Shipyard, Dumbarton, have received an order to build a passenger vessel propelled by Diesel-electric machinery for service on the West Coast of Scotland, by Messrs. David MacBrayne & Company, Limited, Glasgow.

THE PULSOMETER ENGINEERING COMPANY, LIMITED, of Reading, report the receipt of substantial orders from the Admiralty, the Mid-Glamorgan Water Board and for the West Rand Consolidated Mines, Limited, for various types of pumps, including fire and bilge, cell and centrifugal.

THE DESTRUCTION OF THE 30,000-ton battleship, H.M.S. "Marlborough," the last of the famous coal-burning ships of the British Navy, began last week at the shipbreaking yard at Rosyth of Metal Industries, Limited. It is estimated that 200 men will be fully employed on the job for nine months.

DURALUMIN MAY BE TINNED by heating the metal to about 151 deg. C., having the surface well cleaned and without using any tinning flux. Heat the tin or tinning alloy to between 180 deg. C. and 195 deg. C., and with the aid of a wire scratch brush, briskly rub the molten tinning metal on to the duralumin.

MR. A. J. GRANT, managing director of Thomas Firth & John Brown, Limited, speaking on the results achieved at Ottawa, said that he found signs of definite improvement in the iron and steel industry which he felt sure would lead to a general trade revival as the effect of the Conference comes into force. "In my view," he said, "this advance will become pronounced by the end of the year."

MESSRS. LITHGOWS, LIMITED, Port Glasgow, have launched the cargo steamer "Baron Douglas," which has been built to the order of Messrs. H. Hogarth & Sons, Limited, Glasgow. The vessel has been designed to carry 6,500 tons deadweight, and has a length of 376 ft., a breadth of 51 ft. 6 in. and a depth of 26 ft. The boilers and propelling machinery are being supplied by Messrs. David Rowan & Company, Limited, Glasgow.

IT WAS ANNOUNCED at the annual meeting of the Barrow Hematite Steel Company, Limited, last week that the company had signed a contract with the London Midland & Scottish Railway Company for the purchase of the goodwill of the steelworks at Crewe. The United Steel Companies, Limited, had been invited to participate. The chairman added that under the arrangement the greater portion of the steel materials rolled by the railway company at Crewe would for the next 10 years be rolled by the Barrow and United Steel companies.

THE NEW PIPE LINE to be laid in Palestine for the Iraq Petroleum Company, Limited, will prove to be a unique construction. Possibly, never in the world's history have 600 miles of large-diameter pipe been laid across complete desert. A big proportion of the tonnage of pipes needed is being supplied by Messrs. Stewarts & Lloyds, Limited. All essential materials will, of necessity, have to be imported and conveyed from the ports to the actual site on which they are to be used. Such items include not only engineering supplies, which will be necessary in immense quantities, but supplies for the personnel. Much use will be made of motor lorries, and Leyland Motors, Limited, are supplying a large number of vehicles, including the Leyland "Beaver" type.

AT THE ANNUAL PRIZE-GIVING and reopening ceremony of the Paisley Technical College, the Principal, Dr. L. F. Richardson, made an announcement of considerable interest to the unemployed of the town. The enrolment for the year was 1,425, he said, which was rather less than last season. The decrease was due to the industrial depression, but he would suggest to any unemployed that their state offered a wonderful opportunity for study—an opportunity which might never occur again. The unemployment exchange had been very helpful in adapting their regulations to the need of students. The College would charge no fee to anyone who was on the unemployment register. The Paisley Rotary Club, continued the doctor, had made a generous grant in aid of books and instruments for anyone in this difficulty. On obtaining work, it would be easy to change over from day classes to the corresponding evening classes.

THE ANNUAL RETURN of engineering and financial statistics relating to electricity supply in Great Britain for 1930-31, issued by the Electricity Commission, deals in all with 666 separate authorised undertakers, having 483 generating stations, of which 252 are owned by public authorities and 231 by companies. The number of units sold to consumers (including retail distribution of bulk supplies) was over 9,073 millions, showing an increase of 408 millions on 1929-30. On the basis of the estimated population of Great Britain, 44.7 millions in 1920, the sales of electricity by all authorised undertakers in 1930-31 represented an average consumption of approximately 203 units per head of the population. The number of consumers at the end of 1930-31 was 4,014,895, an increase of upwards of 543,000, or over 15 per cent., on the figures for the previous year. Over 81 per cent. of the total public supply of electricity for the year was sold to consumers, the remaining 19 per cent. being accounted for by the works requirements of the undertakers themselves, and by losses in transmission and distribution. With regard to the different classes of supply, power supplies accounted for about 59 per cent., lighting and domestic supplies for 30 per cent., and traction supplies for about 9 per cent. of the total units sold to consumers. Sales of electrical energy for lighting and domestic purposes increased by 400,000,000 units, while the sales for power purposes under the adverse industrial conditions of 1930-31 showed a decrease of 37,000,000 units. Public supply undertakings were consumers of coal and coke to the extent of over 8,685,000 tons in 1930-31, this figure including over 941,000 tons of pulverised coal.

New Companies.

Tate & Company (Ealing), Limited.—Capital £1,000. Engineers. Directors: A. P. Bunt, 13, Mount Park Crescent, Ealing, London, W.; C. L. Bunt.

T. T. N. Patents, Limited, "Park Gardens," Alfold, Surrey.—Capital £2,100. Ironfounders and engineers. Directors: A. C. Trimmer, T. B. T. and C. R. Keeley.

Corfield-Sigg, Limited, 469, Holloway Road, London, N.—Capital £10,000 in £1 shares. Hardware manufacturers. Directors: J. Corfield and S. D. Nicholls.

Bedford Plough & Engineering Company, Limited.—Capital £15,300. Directors: F. Ray, 25, Cauldwell Street, Bedford; D. Whitehouse, A. Nightingale and B. G. Shorten.

Obituary.

THE DEATH OCCURRED at his residence, 38, Warren Hill, of Mr. E. Morgan, of Briton Ferry. He was the son of the late Mr. Thomas Morgan, an ironfounder at the Briton Ferry Ironworks, where Mr. Morgan was himself employed for 39 years, working later at Messrs. Taylor & Son's Engineering Works for 20 years.

Personal.

SIR HARRY MCGOWAN, chairman of Imperial Chemical Industries, Limited, left England last Saturday in the "Empress of Britain" for a brief visit to Canada and the United States.

MR. W. HEELEY, WH.S., of 117, Stafford Road, Waddon, Croydon, lately general manager of Southern Foundries, Limited, has joined the sales staff of Messrs. Joseph Stubbs, Limited, of Manchester. He will generally cover South of England territory.

DR. HAROLD MOORE, C.B.E., who has for many years been Director of Metallurgical Research at the Research Department, Woolwich, has been appointed as from October 1, 1932, Director of the Research Association to succeed Dr. R. S. Hutton, who has been elected to the new Goldsmiths Professorship of Metallurgy at Cambridge University.

MR. F. C. FAIRHOLME, one of the best-known figures in the Sheffield steel trade, has terminated his appointment as joint managing director of Messrs. Thomas Firth & John Brown, Limited. Mr. Fairholme was managing director of Messrs. Thomas Firth & Sons, Limited, for nearly a quarter of a century, and when the amalgamation with Messrs. John Brown & Company took place last year, he became joint managing director of the new firm with Mr. A. J. Grant. He has been particularly prominent in connection with the development of stainless steel. He is chairman of the Firth Brearley Stainless Steel Syndicate, Limited, deputy chairman of Messrs. Davy Bros., Limited, and a Vice-President of the Federation of British Industries.

Wills.

FISHER, J. A., of Shortlands, Kent, formerly chairman of Bell's United Asbestos Company, Limited £41,420

GIBBS, FRANCIS J., King's Heath, for 30 years connected with Elliott's Metal Company £19,861

WOOD, ALBERT, of Conway, Carnarvon, interested in Messrs. Henry Wood & Company, Limited, Dee Ironworks, Saltney £83,986

WATTS, PERCIVAL M., Sidcup, Governing Director of Watts, Fincham & Company, Limited, metal merchants, Billiter Street, E.C. £83,901

Company Reports.

Brown Bros., Limited.—Interim dividend on the ordinary shares of 2½ per cent.

Amalgamated Zinc (De Bavay's), Limited.—Dividend at the rate of 5 per cent. per annum for the six months ended June 30 last.

Neepsend Steel & Tool Corporation, Limited.—Net profit, £9,230; brought in, £5,239; dividend for the year on the ordinary shares of 5 per cent.; carried forward, after payment of preference dividend, £5,496

R. & W. Hawthorn, Leslie & Company, Limited.—Profit, after crediting interest on investments, £14,427; brought in, £18,176; dividend of 6 per cent., less tax, for the year, £21,496; carried forward, £11,107.

Hardness Induced by Cold Work.—According to a contribution by Sadajirô Kokubo in the Tôhoku Science Reports, the change in hardness of metal plates caused by bending has been measured with a Vickers hardness tester; the materials used were Armco-iron, 0.2 and 0.7 per cent. carbon steels, copper, brass, aluminium, duralumin and magnesium. The hardness bending curves showed that, in cold-rolled specimens, the hardness on the convex side decreased, at first rapidly and afterwards slowly, with an increasing bending of the specimen, while on the concave side it increased slightly, and also that in the annealed specimens the hardness on the convex side decreased at first rapidly, and after passing through a minimum increased slightly, with an increasing bending of the specimen, while on the concave side the hardness always increased. These changes in hardness may satisfactorily be explained as the combined effect of the applied stress and the work hardening caused by the bending of the specimen.

Raw Material Markets.

Increased activity continues to be witnessed in the iron and steel markets, and prospects for the winter season are decidedly more favourable than they were a month or two ago. A more satisfactory turnover was recorded last week, and a heavier volume of inquiries is being received. In the pig-iron section, however, forward buying is restricted by the knowledge that the makers still have large stocks of unsold material on their hands. The finished-steel trade is still handicapped by the inactivity in the shipbuilding industry, but increased business is looked for in other directions. Satisfaction is expressed at the extension of Government credit facilities for trade with Russia, and it is hoped that further orders may now be secured.

Pig-Iron.

MIDDLESBROUGH.—A substantial proportion of the Cleveland make is now being absorbed by the producers' own works, but there has also been an increase in business with consumers, who are not so persistent in their efforts to secure a lowering of the price level. Several small contracts have been fixed for delivery ahead. The market has also been considerably heartened by the increased number of inquiries. Export business has, however, shown little response. For home trade, ironmasters' fixed minimum prices remain :—No. 1 Cleveland foundry iron, 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d., and No. 4 forge, 57s., f.o.t. or f.o.b.

Business in East Coast hematite maintains its upward tendency. Stocks are large, however, and the statistical position is causing anxiety. One of the two furnaces restarted at the Ayresome Ironworks is to produce ferro-silicon, and the other hematite. Quotations have now steadied, merchants not being disposed to undersell the producers. Ordinary East Coast brands are selling at 60s., with No. 1 grade of iron at 60s. 6d. On the North-West Coast, Bessemer mixed numbers continue nominally at 66s. per ton. The local consumption is good and there is a fair demand from overseas, but otherwise business is slow.

LANCASHIRE.—This market fails to show the improvement recorded elsewhere. New business remains scarce, while deliveries into consumption have shown a slight falling-off. This seems due, not to any great reduction in activity at the foundries, but rather to the increased use of scrap material, large supplies of which can be obtained very cheaply indeed in this district. Pig-iron prices are steady at 67s. per ton, delivered to works in the Manchester area, for Derbyshire, Staffordshire, and North-East Coast brands of No. 3, 65s. 6d. for Northants, 62s. for Derbyshire forge iron, about 84s. 6d. for Scottish foundry, and about 81s. for West Coast hematite. Indian brands are unchanged at about 67s. to 75s. per ton.

MIDLANDS.—Neither the light nor heavy-engineering foundries are buying much pig-iron at the moment. Most consumers are carrying very small stocks now, owing to general financial stringency. However, should there be any revival in the consuming industries, as seems quite possible at the moment, there may be a considerable wave of buying—a very necessary development, in view of the heavy stocks at furnaces. Prices are unchanged at 62s. 6d. for No. 3 Northants and 66s. for North Staffordshire. Derbyshire and Lincolnshire No. 3, including delivery to Birmingham and Black Country stations. Cleveland No. 3 is also still obtainable at 66s. per ton, delivered.

SCOTLAND.—The price of foundry iron has been reduced by 2s. per ton, making the official minimum 67s. 6d. for No. 3 foundry f.o.t. furnaces, with 2s. 6d. extra for No. 1—the first alteration since July last year. For Middlesbrough No. 3 foundry iron the price is still 55s. 6d. per ton f.o.t. Falkirk, with other English irons quoted at about 1s. 6d. less, but owing to the slackness in the light-castings trade the demand is very poor. Until the state of consumers' order-books shows considerable improvement there can be no departure from the present policy of hand-to-mouth buying.

Coke.

Foundry coke remains a slow market. Very little forward buying is reported, although makers are prepared to enter into long-term contracts at present rates. There is little sign of the buying movement usually observed at this season of the year. Best Durham coke is quoted at between 36s. 9d. and 38s. per ton delivered Birmingham, with slightly inferior grades obtainable at 2s. 6d. less. The current quotations for Welsh foundry coke range from 30s. to 45s. per ton, according to analysis, delivered Birmingham and district.

Steel.

The demand for finished steel, although irregular, is showing signs of expansion. With regard to small steel bars, the chief development has been the increase in Continental quotations, which now vary from £5 11s. to £5 12s. 6d. per ton, delivered South Staffordshire. Business in semi-finished steel is only of moderate character. Orders taken by the English works consist chiefly of small quantities for early despatch. Little interest is being displayed in Continental material, the prices of which have again been advanced.

Scrap.

Business remains steady in the Cleveland scrap-iron market, there being an improving demand in one or two sections. Heavy cast iron is quoted at 35s. per ton and machinery metal at 36s. In the Midlands, the chief feature is a slightly better call for light cast-iron scrap, now at 35s. 6d., delivered. Heavy cast-iron machinery scrap is offered at 45s. In South Wales, the demand for scrap has slightly receded, owing to inactivity at the foundries. Similar conditions prevail in Scotland.

Metals.

Copper.—The market remains fairly secure, although shaken from time to time by the uncertain financial conditions. The increase in prices has, of course, been largely due to a turn-round in market sentiment, business with consumers showing little improvement. A feature of the market is the increased demand for copper-bearing scrap, particularly for gunmetal.

Closing quotations :—

Cash.—Thursday, £38 to £38 2s. 6d.; Friday, £35 15s. to £35 17s. 6d.; Monday, £36 to £36 1s. 3d.; Tuesday, £31 10s. to £31 12s. 6d.; Wednesday, £33 7s. 6d. to £33 8s. 9d.

Three Months.—Thursday, £38 1s. 3d. to £38 2s. 6d.; Friday, £35 15s. to £35 17s. 6d.; Monday, £36 to £36 1s. 3d.; Tuesday, £31 10s. to £31 12s. 6d.; Wednesday, £33 6s. 3d. to £33 7s. 6d.

Tin.—Recently the price of tin has receded in accordance with the sudden reaction on the world's markets, but the metal has since regained its upward tendency. The position of the consuming trades has improved slightly, most works also having let their stocks run very low. This has been particularly the case in the United States, where considerable buying of tin by consumers has been witnessed during the last week or so. It seems that, given a further slight improvement in industrial conditions, a considerable buying movement will be unleashed.

Official closing prices :—

Cash.—Thursday, £157 15s. to £157 17s. 6d.; Friday, £155 15s. to £156; Monday, £155 to £155 5s.; Tuesday, £147 10s. to £147 15s.; Wednesday, £151 12s. 6d. to £151 17s. 6d.

Three Months. — Thursday, £159 5s. to £159 7s. 6d.; Friday, £157 5s. to £157 10s.; Monday, £156 15s. to £157; Tuesday, £149 to £149 10s.; Wednesday, £153 5s. to £153 10s.

Spelter.—The recent set-back in market quotations is offset by the reported improvement in the galvanising industry and in the increased demand for spelter in the overseas markets. There is unlikely to be any further weakening in the price.

Daily fluctuations :—

Ordinary.—Thursday, £16 6s. 3d.; Friday, £15 11s. 3d.; Monday, £15 12s. 6d.; Tuesday, £15; Wednesday, £14 16s. 3d.

Lead.—The reaction in lead, brought about largely by profit-taking, is welcomed as revealing the true strength of the market, which continues to be well supported by the consuming industries, several units of which have reported a favourable demand for their products during the last two weeks.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £14 1s. 3d.; Friday, £13 2s. 6d.; Monday, £13 8s. 9d.; Tuesday, £12 6s. 3d.; Wednesday, £12 15s.

Fusion Welding as Related to Steel Castings.

(*Continued from page* 158.)

Report No. 13. *Tensile Tests.*—The chemical composition used was C 0.38, Mn 1.24, Si 0.42, Cr 0.74 and Mo 0.33 per cent. An unwelded bar (No. 80), normalised at 895 deg. C. and tempered at 690 deg. C., gave 46.0 tons tensile, 31.5 tons yield point, 21.9 per cent. elongation and 31.1 per cent. reduction of area. Two welded bars (Nos. 81 and 82), normalised at 895 deg. C. and tempered at 690 deg. C., after welding with bar cast in material used for Report No. 14, averaged 32.6 tons tensile, 28.2 tons yield point, 5.5 per cent. elongation and 18.4 per cent. reduction.

Report No. 14. *Tensile Tests on Welded Bars.*—Full-annealed 2 hrs. at 895 deg. C., after welding with rod made from C 0.44, Mn 0.55, Si 0.64, Cr 18.22 and Cu 0.91 per cent. Four bars (Nos. 83 to 86) averaged 40.0 tons tensile, 23.9 tons yield point, 9.2 per cent. elongation and 9.7 per cent. reduction.

Report No. 15. *Tensile Tests on Welded Bars.*—Normalised at 895 deg. C. and tempered at 690 deg. C., after welding with two grades of rods, using metal of C 0.30, Mn 1.32 and Si 0.45 per cent.

	Rod.	M.S. Tons per sq. in.	Y.P. Tons per sq. in.	E. in 2 in. Per cent.	R. of A. Per cent.
No. 87 ..	C	29.2	18.3	17.2	39.4
No. 88 ..	C	29.2	18.5	18.5	51.4
No. 89 ..	D	36.4	21.6	18.5	57.5
No. 90 ..	D	36.4	21.6	11.7	25.1

Rod D was rolled and contained C 0.47, Mn 1.98, Si 0.56, S 0.020, and P 0.020 per cent.

(*To be concluded.*)

Continental Steel Cartel.

The reports circulated to the effect that the Continental Steel Cartel is to be reconstituted and international selling syndicates are to be established are stated in Paris circles to have been issued with a pronounced purpose. It is, however, a fact that the Belgian makers are shortly to meet to discuss their differences in the matter of the Cartel.

The following figures show in metric tons the ingot outputs in July of the various countries in the Continental Steel Cartel (and in brackets their quotas) :—Germany, 429,000 (964,000); Belgium, 170,000 (257,000); Luxemburg, 160,000 (176,000); Saar district, 104,000 (139,000); France, 465,000 (660,000); total, 1,328,000 (2,196,000). Hence the total deficiency was 868,000 metric tons.

Iron and Steel Production.

The National Federation of Iron and Steel Manufacturers, in their Statistical Bulletin for July, state that the number of blast furnaces in operation declined towards the end of July by 13 to 56, though it is hoped that eight of them which ceased operations are only temporarily "damped down." The production of pig-iron in July amounted to 292,600 tons compared with 311,400 tons in the previous month, and 317,000 tons a year ago. The production of steel ingots and castings amounted to 432,000 tons, compared with 459,300 tons last June and 428,700 tons in July a year ago.

At an extraordinary general meeting of Quality Steels, Limited, held at 70, Pall Mall, London, recently, it was resolved that the company be wound up voluntarily. Mr. Philip J. Stephens, 24, Coleman Street, London, E.C.2, was appointed liquidator.

OVER
2000 PAIRS OF
Sterling
ROLLED STEEL
MOULDING BOXES
ARE IN DAILY USE IN
MESSRS WALLWORK'S
FOUNDRY.
A view of which
you see here.

Wallwork

For quantity production of accurate castings the name of Henry Wallwork & Co., of Manchester, stands pre-eminent. Sterling Boxes help them to maintain their reputation and supremacy.

STERLING BOXES ARE A PROFIT PAYING PROPOSITION

STERLING FOUNDRY SPECIALTIES Limited
LONDON OFFICE—13 VICTORIA STREET, S.W.1
AGENTS AT MANCHESTER,
GLASGOW & NEWCASTLE-ON-TYNE.
BEDFORD

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	33	7	6
Three months	33	6	3
Electrolytic	37	0	0
Tough	33	5	0
Best selected	33	10	0
Sheets	68	0	0
India	47	10	0
Wire bars	37	0	0
Do., Oct.	37	0	0
Do., Nov.	37	0	0
Ingot bars	36	0	0
H.C. wire rods	41	0	0
Off. av. cash, August	31	9	1 3/4
Do., 3 mths., August	31	6	8 3/4
Do., Sttlmnt., August	31	8	11 7/11
Do., Electro, August	35	2	4 7/11
Do., B.S., August	33	15	3 1/2
Do., wire bars, August	35	9	1 7/11
Solid drawn tubes			10 1/2d.
Brazed tubes			10 1/2d.
Wire			7d.

BRASS.

Solid drawn tubes	9 1/2d.
Brazed tubes	11 1/2d.
Rods, drawn	8 1/2d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	8d.
Wire	7 3/4d.
Rolled metal	7 1/2d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£	s.	d.
Standard cash	151	12	6
Three months	153	5	0
English	152	10	0
Bars	151	0	0
Straits	153	0	0
Australian	151	10	0
Eastern	155	15	0
Banca	134	10	0
Off. av. cash, August	142	2	4 7/11
Do., 3 mths., August	143	12	3 1/2
Do., Sttlmt., August	142	1	1 7/11

SPELTER.

	£	s.	d.
Ordinary	14	16	3
Remelted	15	5	0
Hard	12	10	0
Electro 99.9	17	5	0
English	16	0	0
India	15	5	0
Zinc dust	21	0	0
Zinc ashes	2	2	6
Off. aver., August	13	14	4 1/2
Aver. spot, August	13	11	10 1/2

LEAD.

	£	s.	d.
Soft foreign ppt.	12	15	0
Empire	12	18	9
English	14	10	0
Off. average, August	11	9	4 1/2
Average spot, August	11	6	11 13/28

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	0	0
Do., V.M. ex-whse.	22	10	0
Rods	27	0	0
Boiler plates	23	0	0
Battery plates	—		

ANTIMONY.

	£	s.	d.	to	£	s.	d.
English	35	0	0	to	42	10	0
Chinese					25	0	0
Crude					16	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	9	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£13 15 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10 1/2d. lb.
Ferro-phosphorus, 20/25%	£20 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£34 5 0
4/6% car.	£25 15 0
6/8% car.	£24 10 0
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£37 5 0
Max. 1% car.	£44 10 0
Max. 0.70% car.	£45 17 6
70% carbon-free	1/- lb.
Nickel—80/99.5%	£240 to £245
"F" nickel shot	£216 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4 1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under 1/2 in. to 1/4 in. 3d. lb.
Do., under 1/4 in. to 7/16 in. 1/- lb.
Flats, 1/2 in. × 1/4 in. to under 1 in. × 1/8 in. 3d. lb.
Do., under 1/2 in. × 1/4 in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	to	£	s.	d.
South Wales—							
Heavy steel	1	18	0	to	1	19	0
Bundled steel and shrngs.	1	15	0	to	1	18	6
Mixed iron and steel	1	15	0	to	1	16	0
Heavy cast iron	2	2	6	to	2	3	6
Good machinery	2	5	0	to	2	7	6
Cleveland—							
Heavy steel					1	15	0
Steel turnings					1	8	0
Cast-iron borings					1	2	6
Heavy forge					2	10	0
W.I. piling scrap					2	2	6
Cast-iron scrap	1	15	0	to	1	16	0
Midlands—							
Light cast-iron scrap					1	15	6
Heavy wrought iron					2	2	6
Steel turnings, f.o.r.					0	19	0
Scotland—							
Heavy steel					1	12	6
Ordinary cast iron					1	19	0
Engineers' turnings					1	7	6
Cast-iron borings					1	10	0
Wrought-iron piling					2	0	0
Heavy machinery					2	4	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	24	0	0
Brass	17	0	0
Lead (less usual draft)	11	10	0
Tea lead	10	0	0
Zinc	7	10	0
New aluminium cuttings	74	0	0
Braziery copper	21	0	0
Gunmetal	18	0	0
Hollow pewter	82	0	0
Shaped black pewte	65	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	60/6
Hematite M/Nos.	60/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	70/-
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—
*d/d Black Country dist.	
Scotland—	
Foundry No. 1	72/-
No. 3	67/6
Hem. M/Nos. d/d	67/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	84/6
Clyde, No. 3	84/6
Monkland, No. 3	84/6
Summerlee, No. 3	84/6
Eglinton, No. 3	84/6
Gartsherrie, No. 3	84/6
Shotts, No. 3	84/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	to	£	s.	d.
Iron—							
Bars (cr.)	9	5	0	to	9	15	0
Nut and bolt iron	7	15	0	to	8	10	0
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, 3/4 in. × 4 in.					12	0	0
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	7	6	to	9	5	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5 1/2 in.					9	7	6
Rounds under 3 in. to 3/8 in. (Untested)			6	12	6	& up.	
Flats—8 in. wide and over					8	12	6
under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	0	0
Hoops (Staffs)					9	10	0
Black sheets, 24g.	8	0	0	to	8	10	0
Galv. cor. shts.	9	2	6	to	9	10	0
Galv. flat shts.	9	12	6	to	10	10	0
Galv. fencing wire, 8g. plain					12	15	0
Billets, soft	4	17	6	to	5	7	6
Billets, hard					6	12	6
Sheet bars	4	15	0	to	5	5	0
Tin bars					4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10 3/4d.
Sheet to 10 w.g.	11 3/4d.
Wire	11 1/2d.
Rods	10 3/4d.
Tubes	16 1/2d.
Castings	12 3/4d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/2 to 1/7 1/2
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated

	Dols.
No. 2 foundry, Phila.	13.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	43.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.10
Sheets, galv., No. 24	2.75
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
furnace	16/-
Durham and Northumberland—	
foundry	21/- to 25/-
furnace	12/-
Midlands, foundry	—
furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	15/6
	28×20 "	31/-
	20×10 "	—
	18 3/4×14 "	—
C.W.	20×14 "	—
	28×20 "	—
	20×10 "	—
	18 3/4×14 "	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	0	0
Bars-hammered, basis	£16	10	0	to	£17	0	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	5	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.	
Sept. 8 ..	38	0	0	inc. 6/3
,, 9 ..	35	15	0	dec. 45/–
,, 12 ..	36	0	0	inc. 5/–
,, 13 ..	31	10	0	dec. 90/–
,, 14 ..	33	7	6	inc. 37/6

Electrolytic Copper.

	£	s.	d.	
Sept. 8 ..	40	0	0	No change
,, 9 ..	39	0	0	dec. 20/–
,, 12 ..	39	0	0	No change
,, 13 ..	35	0	0	dec. 80/–
,, 14 ..	37	0	0	inc. 40/–

Standard Tin (cash).

	£	s.	d.		
Sept. 8 ..	157	15	0	inc.	2/6
,, 9 ..	155	15	0	dec.	40/–
,, 12 ..	155	0	0	,,	15/–
,, 13 ..	147	10	0	,,	150/–
,, 14 ..	151	12	6	inc.	82/6

Tin (English ingots).

	£	s.	d.	
Sept. 8 ..	159	10	0	No change
,, 9 ..	157	10	0	dec. 40/–
,, 12 ..	157	0	0	,, 10/–
,, 13 ..	148	10	0	,, 170/–
,, 14 ..	152	10	0	inc. 80/–

Spelter (ordinary).

	£	s.	d.		
Sept. 8 ..	16	6	3	dec.	3/9
,, 9 ..	15	11	3	,,	15/–
,, 12 ..	15	12	6	inc.	1/3
,, 13 ..	15	0	0	dec.	12/6
,, 14 ..	14	16	3	,,	3/9

Spelter (Electro, 99.9 per cent.).

	£	s.	d.		
Sept. 8 ..	18	15	0	dec.	2/6
,, 9 ..	18	0	0	,,	15/–
,, 12 ..	18	0	0	No change	
,, 13 ..	17	7	6	dec.	12/6
,, 14 ..	17	5	0	,,	2/6

Zinc Sheets (English).

	£	s.	d.		
Sept. 8 ..	24	0	0	inc.	20/–
,, 9 ..	24	0	0	No change	
,, 12 ..	24	0	0	,,	,,
,, 13 ..	24	0	0	,,	,,
,, 14 ..	24	0	0	,,	,,

Lead (English).

	£	s.	d.		
Sept. 8 ..	16	0	0	dec.	5/–
,, 9 ..	15	5	0	,,	15/–
,, 12 ..	15	5	0	No change	
,, 13 ..	14	5	0	dec.	20/–
,, 14 ..	14	10	0	inc.	5/–

Imports and Exports of Iron and Steel Castings in August and the eight months 1932, compared with August and the eight months 1931.

	August, 1931.	August, 1932.	Eight months, 1931.	Eight months, 1932.	August, 1931.	August, 1932.	Eight months, 1931.	Eight months, 1932.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	1,351	107	9,424	1,957	17,333	2,361	119,289	34,595
Castings, in the Rough, Iron	98	5	1,117	536	2,169	149	22,555	9,625
,, ,, ,, Steel	552	81	4,208	1,289	12,452	1,806	90,633	25,201
Hollow-ware, Cast, not Enamelled	4	7	56	22	457	449	4,016	1,687
,, ,, Enamelled	3	70	45	141	209	1,720	2,207	4,048
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	70	17	615	262	4,479	411	28,454	9,390
,, Irish Free State	524	186	2,837	2,612	20,540	10,116	131,654	118,009
,, British South Africa	314	120	1,523	1,019	8,795	4,011	55,325	36,256
,, ,, India	165	24	954	554	7,460	863	34,856	19,073
,, New Zealand	21	36	278	224	820	2,534	17,547	11,785
Total (including other countries)	1,342	627	8,986	7,285	53,849	28,220	395,293	304,296
PIPES AND FITTINGS—CAST—								
To Argentine Republic	460	—	3,995	1,303	4,646	44	39,068	13,973
,, Irish Free State	1,201	302	9,969	4,744	13,656	4,660	110,911	65,982
,, British South Africa	530	51	5,700	2,782	5,832	1,016	66,827	34,693
,, ,, India	270	24	1,213	733	3,210	391	20,023	12,487
,, Straits Settlements and Malay States	224	90	2,141	1,587	2,141	1,404	22,768	16,977
Total (including other countries)	5,238	4,178	50,023	45,029	54,974	40,780	568,303	463,374
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	127	175	1,468	1,589	4,625	5,815	50,954	56,227
,, Enamelled	32	81	349	558	3,703	6,176	34,956	46,733
CASTINGS, in the rough—								
Iron	96	46	1,763	683	2,929	1,863	32,240	25,600
Steel	70	85	894	559	2,107	2,789	30,956	23,393

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(A remittance should accompany instructions.)

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BRASS FOUNDRY FOREMAN desires position; experienced in Admiralty contracts, gunmetal, phos. bronze and manganese castings; 12 years foreman in last situation.—Box 258, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman desires position, experience all classes Engineering and Jobbing work, iron and non-ferrous; thorough knowledge of metallurgy and mixing of metals; expert on cupola; take entire charge.—Box 260, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, a Foreman Ironmoulder with experience in modern methods of greensand, dry-sand and loam moulding.—Apply in writing, stating age, experience, and salary required, to THE CENTRAL MARINE ENGINE WORKS, West Hartlepool.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

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Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

POSITION required by young man just completed Full-time Course in Foundry Practice. Has had several years' experience as Analytical Chemist. Has extensive knowledge of Iron, Steel Works and Foundry Practice. Position desired as Metallurgist or executive position with prospects. (190)

POSITION required as Foundry Metallurgist or foundry executive position. Sound practical experience moulding, core-making, cupola and pattern shop. Good technical and commercial training. (191)

POSITION required as Foreman or Assistant Foreman, by young Moulder with good experience in general Engineering Foundries, including Iron, Steel, Malleable and Non-ferrous. City and Guilds Diploma. (192)

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MACHINERY.

FOR Sale, one MacDonald No. 24 Jarr Moulding Machine with table 7 ft. 6 in. square.—Apply, JAMES W. ELLIS & COMPANY, LIMITED, 9, Ellison Place, Newcastle-upon-Tyne.

JACKMAN CUPOLETTE, complete with fan and pipes, equal to new, £30.—A. HAMMOND, 14, Australia Road, Slough.

TILGHMAN Sand-blast Room, 12 ft. x 9 ft., in C.I. Sections.

Tilghman Rotary Barrel Sand-blast Plant, 36 in. x 30 in. Complete with Tilghman B.H. 4½ Compressor.

Macdonald No. 9 "Ajax" Pneumatic Jarr Turnover P.D. Moulding Machine.

Fordath "Senior" Rotoil Core Sand Mixer.

Pneulec Royer No. 1 Sand Mixer.

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Twenty Adaptable Moulding Machines.

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Tabor Pneumatic Portable Rollover Moulding Machine.

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15-ton No. 20 Inclinable Power Press, by Rhodes.
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OUR DEXTRIN CORE GUM, reliable strength, has a reputation all over England as well as abroad. Please post us your inquiry, stating quantity, for carriage-paid terms.—WILLIAM OLSEN, LIMITED, The Foundry Suppliers, Hull.

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10-Ton "Stevenson" £48
8-Ton "Evans" ladle, new ... £42
4-Ton "Evans" £28
2-Ton "Evans" £19

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14"×16" Mumford split pattern ... ... 2 @ £30 each
30"×40" Tabor rollover, as new £160
No. 2 Britannia Jolters ... 2 @ £36
No. 0 Britannia Jolters ... 4 @ £20
Core Jolters, 3" Cylinder new, £4 each

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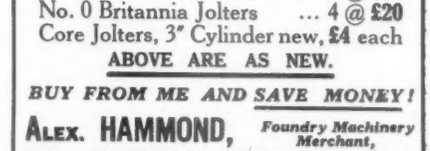

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